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WHEN all production departments are not working at full capacity, the all-around welder can be made one of the most valuable workmen on the payroll. In many plants his principal job is supposed to be the repair of equipment parts which become broken in service. This range of work probably represents less than half of the valuable work the plant welder can do. There are many chances to improve storage facilities and conveying equipment by welding, and many kinds of equipment which can be made to handle much heavier loads by welding on reinforcements, and many parts which can be kept longer in service without replacement or adjustment by the application of hard facing materials in some cases, and by the application of bronze in other cases. There is certainly no reason why the welder should be allowed to work only part time or to be shifted to other work during any slack season. Such a season is really the ideal time for him to do some of his most effective work with a minimum interference to the operating program.

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EDITORIAL

Increasing Gas Welding Speed

DURING the past few months the welding trade journals on the European continent have been showing a great deal of interest in a new type of oxy-acetylene welding torch, the development of which is generally credited to Prof. Keel of Switzerland, the distinguishing feature of the new type of torch being the presence of two or more welding flames instead of a single flame, which is characteristic of the conventional gas welding torch. The interest in this development seems to center in the claim that the speed of welding can be increased from 50 to 60 per cent while the actual cost of the welding operation is reduced from 25 to 30 per cent. From reports so far published, it is not apparent just how much progress has been made toward the commercial production of satisfactory equipment of this type. It does appear, however, that the technique of using such equipment on quite a variety of work has been carefully studied and that much valuable operating data has been collected. Undoubtedly if such equipment can show consistent performance along the lines indicated in the current reports, there will be a number of American offerings of torches operating with more than one flame. The multiple-flame tip is not, of course, a new discovery. It has been in use for years in automatic welding machines which have been developed for such work as tank welding and tube welding. Some work has also been done with a multiple flame manual torch, although torches of this construction have not been popularized to a sufficient extent to have produced any published discussions of the possibilities. Here is a subject concerning which a good deal more may be heard in the future. It will mean new developments in apparatus, technique, procedure, preparation of material, and in the end result. The production minded men will probably be most keenly interested in the claims for greater speed. There are, however, additional claims of better welds and less distortion. It is also interesting to note that the multiple-flame idea is expected to be applicable to either low pressure or high pressure torches, and should therefore be adaptable to a very wide range of applications.

Classifying the End Result

ONLY those who have actually been engaged in the work of revising the A. S. M. E. boiler code can realize the amount of work involved in writing and revising and rewriting that was necessary to change the code from the 1925 form until the provisions published last month were formulated. The latest proposed specifications for the welding of unfired pressure vessels and power boilers recognize that vessels of different types are subject to different requirements as far as the quality of the welding is concerned, and we therefore find the final results classified or graded in the latest proposal. This is a feature of the code which will undoubtedly have a far-reaching effect in the welding industry and in a number of other industries which are using the welding processes in fabrication work. Grade C welding under the proposed specifications is very far from being low grade welding. To meet the Grade C specification, in fact, the fabricator will be obliged to use first-class operators and first-class materials. Furthermore, the code places maximum emphasis on inspection and testing of the work and makes the management in each case responsible for the selection and qualification of the operator. In some cases it may appear that the routine of checking the ability of welders and keeping a record of the periodical checks is too burdensome. On the other hand, it has been found in a number of manufacturing plants that this program of periodical checking is a paying proposition—that it automatically results in maintaining a high quality of workmanship which reduces the expense of replacing defective merchandise and makes it easier to sell the welded product because of its reputation for uniform quality. This has been true in plants where no attempt was being made to meet any code requirements of any kind, but it was considered a matter of good business to protect the quality of the finished product in every possible way. The classification of different kinds of work as set forth in the new code show that there is a range of production possibilities from what might be called excellent workmanship up to what might be called practically perfect. The new code is therefore a document which should be studied by all manufacturers who are using the welding processes in production. There are plenty of possible applications of the welding art which have not been adopted because welding results were judged by the class of work done on cheaply made storage tanks. Grade A welding, or in many cases Grade B or C, would change the picture entirely as far as results are concerned. Plant managers who take the trouble to investigate will find that there are no deep, dark secrets involved in the procedure, but just good sound welding principles, conscientiously applied.

The Shielded Arc

DEPENDING upon the point of view, some men in the welding industry would refer to the shielded arc as revolutionary, and others would refer to it as another fad. It is a specialized form of metallic arc welding which apparently has developed from the work done in the welding of special types of pressure vessels. A few manufacturers have been able to produce remarkable results by working with a metallic arc which was very carefully protected from any contamination by the atmosphere. The protective coatings furnished at the present time for commercial arc welding electrodes range all the way from a heavy coating of asbestos down to an electrode which is barely dusted with some chemical preparation. The coatings which furnish maximum protection to the arc are becoming commonly known as shielded-arc types of coatings. With their use, it is possible to produce welds of remarkably high strength and ductility compared to those which were produced several years ago. It is natural that there should be conflicting reports on this new type of arc welding. The new materials which are being supplied for it call for different technique, different current settings and different handling, and the operator who handles these new conditions successfully must be one who is ready to adapt himself to new conditions. Meanwhile, it appears that most of these newer materials are being modified and improved from month to month. It will require time to develop this idea to its highest efficiency, but it has already been carried far enough to show that it has real possibilities, and the welding engineer of today will do well to investigate it thoroughly, because several large users of the "shielded-arc" have certainly done a lot of splendid work with it. Its greatest usefulness may turn out to be along the lines of extending the use of arc welding rather than revolutionizing it.

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Stress Relieving Welded Joints

Speculation on the Nature of Residual Strains in Steel Due to Temperature Change

By Robt. E. Kinkead†

THIS discussion is referred to in the title as speculation for the reason that we have very little scientific knowledge of residual stresses in either the qualitative or quantitative sense. For the most part, such stresses are finite but immeasurable and unknowable at the present time. If there is any justification for speculation on the subject, aside from the pursuit of legitimate scientific curiosity, it will perhaps be found in the belief that such speculation may make it possible for other investigators to increase the volume of measurable phenomena.

Steel expands as its temperature increases and contracts as it cools. Another way of saying the same thing is to say that the volume of steel, other things being equal, is a function of its temperature. This is a conventional statement of doubtful accuracy. Real difficulties multiply rapidly, however, the instant we have a condition in which either thermal expansion or contraction is inhibited—which is true in most cases.

If a pressure vessel should be stress relieved in a furnace why not a building, a ship, or a bridge? If you were to heat a steel bar 36 inches long to the boiling point of water, and clamp the ends so that it could not contract when cooling, what would be the stress per square inch in the bar at 70 degrees Fahrenheit? What may be accomplished by a good welding procedure? Why ductile metal in the weld? Why step-back welding?

These questions and many similar ones are discussed in this article by Mr. Kinkead. These are subjects which are of vital interest to all those who are interested in high-grade welding. It is certain that the welding industry can profit by a generous exchange of experience and opinion on these subjects, and therefore discussion of them is invited.

We can, perhaps, get a foothold in our speculative attack on the problem by considering these simple facts on the conventional quantitative basis. But it will be necessary first to put ourselves in what might be called a "one dimension frame of mind," and be willing to establish certain major premises as facts, although we are fully aware of the fictitious nature of such premises—as will presently appear.

A piece of steel has an expansion and contraction co-efficient of about .000,006,7 inches per inch in each principal dimension, per degree Fahr. If we may think in terms of one dimension only, we may find out what would happen if the steel were not free to contract in this dimension. It will be assumed that a piece of steel exactly one inch long has its temperature decreased one degree Fahrenheit and further that the ends are perfectly inhibited from movement towards each other. This, of course, is a pure fiction, since it assumes a modulus of elasticity of one divided by zero for the substance to which the ends are attached. Since the original one inch cannot change to one inch minus .000,006,7 inches, contraction must occur in the remaining two dimensions. In other words, the section will change—in the dimensions offering the least resistance to change. If we may assume, for the moment, that the section will change uniformly along the one inch dimension, we may calculate the stress set up by a reduction of one degree Fahrenheit in temperature in a fixed length of one inch. This assumption that the stresses will be the same under this condition is far from the truth, as will presently be shown. But if the assumption is used, it would simply be necessary to divide the contraction co-efficient by the reciprocal of Young's Modulus to arrive at the residual stress per inch of length for a contraction of one degree Fahrenheit. Reducing the figures to common fractions, we have:

$$\frac{\frac{67}{10{,}000{,}000}}{\frac{1}{29{,}000{,}000}} = 194.3 \text{ lbs. per square inch}$$

The above figure means, for instance, that if we heated a steel bar 36 inches long to the temperature of 212 degrees Fahr., fixed the ends and cooled it to 70 degrees Fahr., the residual stress would be 27,590.6 lbs. per square inch.

Discounting all of our assumptions by saying that the residual stress would never be as high as the calculations indicate, although it might be in a circular ring shrunk on a

†Consulting Engineer, Cleveland, Ohio.

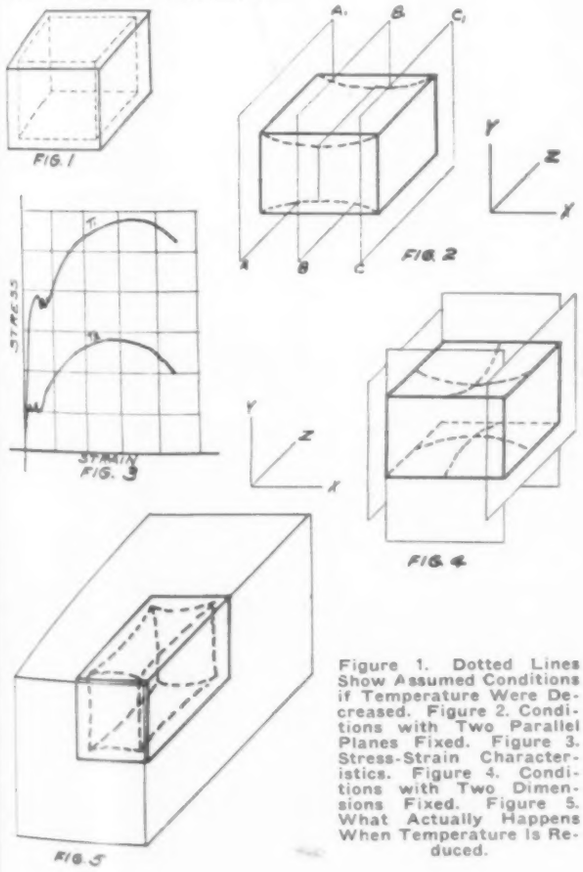


Figure 1. Dotted Lines Show Assumed Conditions if Temperature Were Decreased. Figure 2. Conditions with Two Parallel Planes Fixed. Figure 3. Stress-Strain Characteristics. Figure 4. Conditions with Two Dimensions Fixed. Figure 5. What Actually Happens When Temperature Is Reduced.

mandrel, we still are confronted with the fact that the residual stress might be nearly as high as the calculation indicates. The importance of the matter from the engineering point of view is at once evident when we consider heat engines, electrical machinery and other equipment subject to high operating temperatures which may not be uniform and

Figure 6. How the Two Test Specimens Appeared After Preparation.

relatively high working stresses. Mechanical joints made by welding, where the temperatures reach the vaporization point of steel, certainly complicate matters still further.

In the field of pressure vessels operating at high temperatures and pressures, we are just beginning to inquire into the effect of difference of temperature at various points on the shell of the vessel on its service behavior. That the stresses might be very high, due to such conditions, is an unescapable conclusion. It seems likely that many of our explanations of the service behavior of such vessels will have to be revised when we get a better understanding of what happens in terms of stress when temperature changes occur.

Welded ships, buildings, bridges and heavy machinery parts introduce new problems in this field.

The diagrams shown in Figures 1 to 5 tend to support the statement that our knowledge of the residual stresses in a given case is purely speculative at the present time.

Fig. 1 shows an element of volume of steel. The dotted lines indicate an assumption of what would happen to this volume if its temperature were decreased—in the case in which the element were free to move in any dimension.

This assumption is untenable because it is based on the further assumption that temperature change would occur instantaneously in the element—which is impossible. Such change would always occur from surface to center progressively.

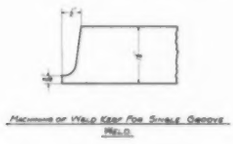
The conditions set forth in Fig. 1 would never occur under any conceivable conditions.

Fig. 2 shows the same conditions as Fig. 1 with the exception that elements of volume are assumed to be fixed and immovable in parallel planes A-A1 and C-C1. Thus, the X dimension is assumed to remain constant. The Y and Z dimensions change to provide reduction in volume with decrease in temperature. The cross section of the element in plane B-B1 is less than the cross section in planes A-A1 and C-C1.

The assumption that the X dimension A-C remains constant under contractional force is never true. Cross section B-B1 depends on the stress-strain characteristic of the steel at each point in the temperature range. Fig. 3 shows that the stress-strain characteristic is a function of stress and temperature.

Thus the assumptions in Fig. 2 are based on fiction.

Fig. 4 shows an element of volume under conditions of



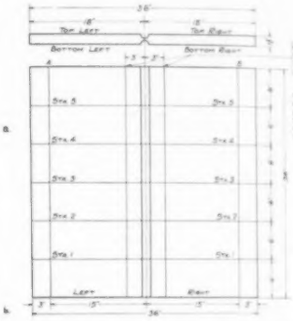


Figure 7 (Left) Detail Dimensions of Kerfs. Figure 8 (Right) Measuring Stations for Observation of Deformation.

contraction due to decrease in temperature but completely inhibited from motion in two dimensions—X and Z. The element is free to move in Y dimension.

The errors in this assumption have been pointed out in connection with Fig. 1 and Fig. 2.

Fig. 5 shows what actually happens under conceivable conditions of temperature reduction in an element of volume of steel. This element of volume is taken in the central part of a larger volume of the metal. Temperature reduction proceeds from the surface inward. The center cools last. When the whole volume is at the same temperature, a state of equilibrium exists. The residual strains set up under these conditions depend on the following factors;—amount of

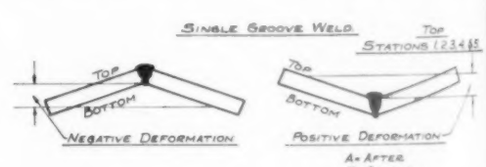
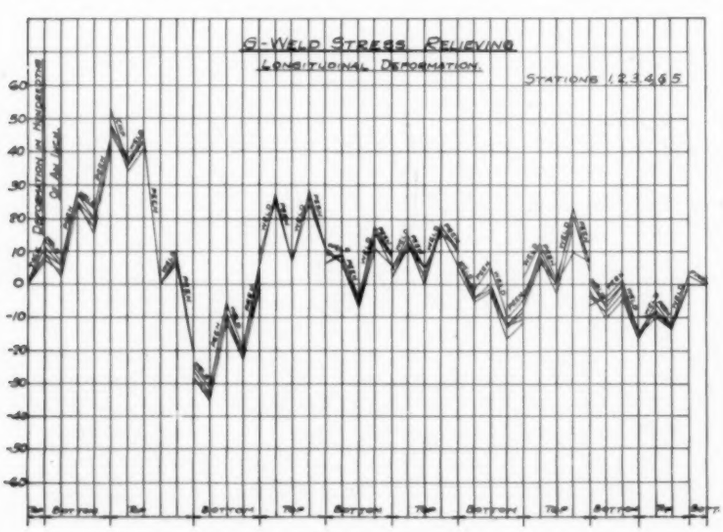
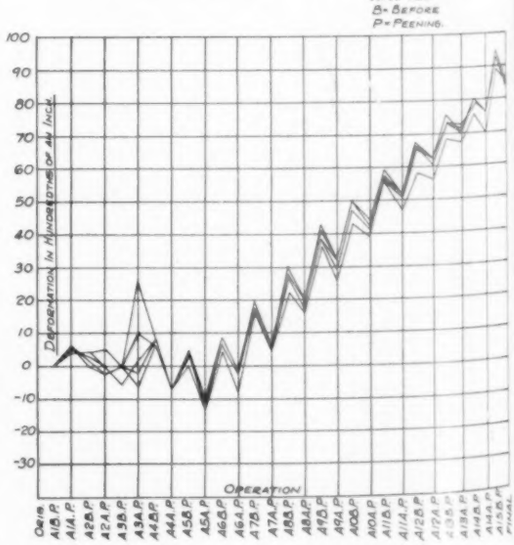


Figure 9 (Below) and Figure 10 (Right) Show Curves of Deformation Measurements Taken as Indicated in Figure 8.





change in temperature, rate of change of temperature, stress-strain characteristic of the steel, the over-all dimensions of the volume involved. The internal rate of change of temperature is immeasurable and therefore the residual strains are not predictable. A further assumption is that the volume of steel is a homogeneous mass—which is wholly unwarranted in view of the facts.

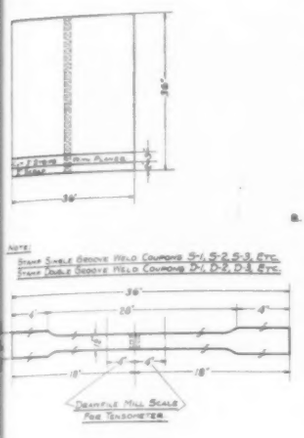


Figure 11. Detailed Dimensions for Cutting Coupons for Testing.

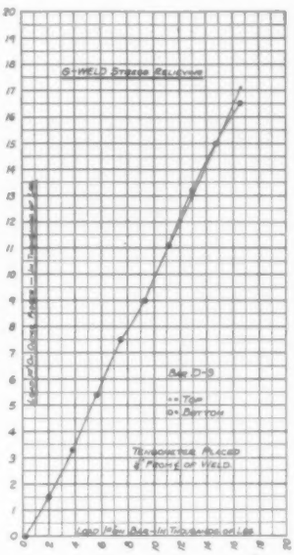


Figure 12. Curves Showing Beam Loading and Stress on Outer Fibres of Coupon.

The most that we can safely say at this point is that residual strain is a function of volume at a certain temperature. If the volume is greater or less than is normal for this temperature, residual stresses may be present. Later in this discussion, test data is produced in an effort to find out whether or not if the volume is normalized by the application of external forces, residual stresses have been completely relieved.

So far as the welding processes are concerned, we are convinced that residual stresses arising from the welding operation itself must be held to known values or eliminated by some kind of treatment after the welding operation is completed.

Details of a series of tests and studies of residual stresses in welds and methods of removal will now be discussed.

Effect of Welding Procedure On Residual Strains

General Method of the Test. Two pairs of plates (Fig. 6) were used for this test; each pair of plates consisted of two 18x36x1½ in. plates of welding quality flange steel. One pair of plates was prepared with a double kerf. The other pair of plates was prepared with a single kerf. Figure 7 shows detail dimensions on these kerfs. In the case of the double kerf seam the welding was carried out as follows:

The plates were tacked together in three places. They were then turned over and a welding bead applied from the reverse side. This welding bead was applied by the step-back welding method, in which the step was approximately 6 inches. The bead was then peened and cleaned with a wire brush. A second bead was then applied to the same side—peening and cleaning as before. The plate was then turned over and chipped out to a depth which made it certain that the weld would extend through the center of the plate. Two beads were applied from this side, peening and cleaning as before. The plate was then turned over and two beads applied to the reverse side. The weld was built up in this manner, up to the final layer, which was applied without peening.

In the case of the single kerf weld, the same general procedure was followed with the exception that the weld was built up all from one side before applying two beads on the reverse side. Peening and cleaning of beads was carried out as before.

Before and after the application of each welding bead, measurements were taken to show the actual amount of warping of the plates in a plane transverse to the weld at five different stations. Measurements were also taken showing the warping of the plates along the weld at a distance of 3 inches on each side of the weld. Figure 8 shows the location of these measuring stations. Figures 9 and 10 show

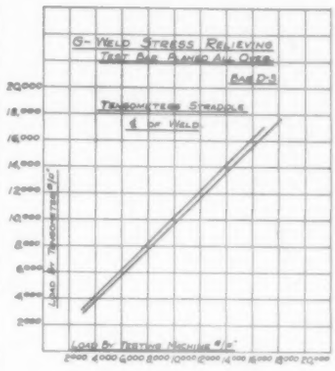


Figure 13. Results of Testing a Coupon Which Was Planed to Remove Reinforcement.

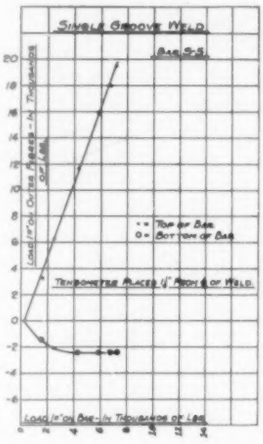

Single Groove Weld
Bar S-3
Load in Thousands of Lbs.
Top of Bar
Bottom of Bar
Tensometer Placed ½" from C of Weld
Load in Thousands of Lbs.

Figure 14. Similar Test Results Procured in Pulling a Single Groove Weld.

measurements taken on both plates, as indicated above.

Referring to the G-WELD plate, which is the double kerf weld, it should be noted that in order to get a continuous curve of performance showing deformation from one side, the readings on the bottom of the plate were referred to the top. The necessity for this arose from the fact that the deformation could only be read conveniently on the upward side of the plate.

Figures 9 and 10 show a detailed history of each set of measurements, the curves of the five stations being superimposed on each other, to indicate the variation in the performance along the plates.

Tests Made After the Welds Were Completed. Coupons were cut in accordance with Figure 11. These coupons were put in a standard testing machine and Huggenberger tensometers were applied in the locality of the weld to discover the stress distribution in the coupons as they were after completing the welding operation. The curves in Figures 12, 13 and 14 show the load per square inch as calculated from the beam loading and also the stress at the outer fibres as shown by the tensometers.

The G-WELD bar, which was straight, was then planed on one surface and was found to be perfectly straight after planing one surface which had the weld reinforcement on it. The opposite surface was then planed an equal amount (about 1-16 inch below the surface of the plate), and the bar was still found to be perfectly straight. The planed bar was then put in the testing machine and the tensometers again applied on the weld and adjacent to it. Figure 13 shows its behavior.

The planed G-WELD bar was then painted with whitewash, which was allowed to dry, and sufficient tension applied to break the bar. None of the whitewash came off at or near the weld at the yield point. Rupture occurred about 6 inches from the end of the bar.

The single grooved bar which had been warped about 9-10 inch, was put in the testing machine and pulled to the breaking point, which occurred at about the same distance from the end as in the previous case. After passing the elastic limit the bar pulled perfectly straight.

Conclusions

In the case of the completed G-WELD bar there was no evidence of residual stress in measurable amount.

In the case of the single grooved weld, had the weld been made in a shell in which the plates were not free to move with reference to each other, a very considerable amount of residual stress would have been locked up in the weld. While it is perfectly true that the locked-up stress might not have been as great as that shown when the deformed plates were pulled in the testing machine with the tensometers on the bar, the unequal stress distribution would have been of a value approaching the values actually measured by the tensometers.

In the case of the single grooved weld, had it been made in a vessel, there is no question but that the vessel should have been stress relieved before putting the vessel into service. Otherwise, there might have been a very great reduction in service life, due to the fact that some of the metal in the plate would have been operated at a stress beyond the safe limit for the metal.

The results indicate that residual stresses can be controlled by mechanical means on 1½ in. plate with entirely satisfactory results, provided the weld is done under a suitable procedure, which involves the following:

1. Step-back welding
2. Ductile metal in the weld
3. Peening each bead as it is applied
4. Welding first on one side; then on the other
5. Applying equal amounts of weld on both sides of the center line through the material joined.

(To be continued)

Penstock Fabrication with the Radiagraph

By W. P. Jones†

The field of fabrication presents a great many opportunities for the use of the Airco-DB No. 1A Radiagraph, with outstanding advantages and economies to the customer.

A notable example, with which I have been recently connected, was the fabrication of penstocks by a plate fabricating plant for a large power project.

This project called for three penstocks, each 14 feet in diameter and approximately 550 feet long. These penstocks are constructed of steel plate, running from ⅝-inch to 1¼-inch in thickness. The thickness of penstock plates increases from inlet to outlet, or from upper to lower end. As the hydraulic head or pressure increases, towards the lower end of penstocks, the heavier plates become necessary.

In each penstock, there are three elbows, constructed on a 25-foot inside radius, of nine sections each. Altogether there are nine such elbows included in the project. One of these penstock elbows is illustrated in Figs. 1 and 2, which show it during the course of erection in the customer's shop.

The Airco-DB No. 1 A Radiagraph was used in cutting all sections of these penstock elbows to proper size and shape employing a curved track. All other necessary courses of plate included in straight runs of penstocks were likewise fabricated with it. Remarkable results were obtained as to speed and economy, when compared with other fabricating methods.

†*Serviceman, Air Reduction Sales Co.*

Figure 1. One of 9 Penstocks Fabricated at the Plant of Commercial Boiler Works, Seattle, Wash., for City of Seattle to be Used at Diablo Dam Power House.

Figure 2. All Sections Cut to Size and Shape with 1A Radiagraph Using a Track Curved to Shape.

There are 29 circumferential seams cut on each penstock. These include all courses in elbows and all necessary straight-run courses. The approximate linear footage of each cut was 55 feet, this being the distance that the torch had to travel in cutting the curved plates for elbow sections, including cuts at ends of plates.

Each seam requires two cuts, or approximately 110 linear feet. The 29 circumferential seams cut on each penstock amounted to 29x110, or 3,190 linear feet. For the three penstocks, the total linear feet cut were 3x3,190, or 9,570, or about 1.8 miles.

It is estimated that about 12,000 cubic feet of oxygen and 3,000 cubic feet of acetylene were required to complete the cutting, with the Radiagraph. As a matter of interest, it may be well to add that this is the second job of this type which has been carried out at this customer's plant within the past year.

It Pays to Be Welding Minded

By J. J. Berliner

One does not expect to go into a hospital, especially one conducted for the care of children, and see a welding shop, but that was the writer's experience recently. The Hospital Ste. Justine, Montreal, has one of the best equipped welding shops, although not one of the largest, to be seen anywhere, and, like every other department in the building, it is a model of cleanliness and orderliness.

This welding shop was inaugurated, strange as it may seem, by a lady, Sister Victoire de Jesus, who is responsible for the purchasing of equipment. Having some knowledge of what work could be done by welding and what savings could be effected thereby, she saw no reason why a hospital should not take advantage of these facts and manufacture its own equipment on the premises. The result has been that thou-

sands of dollars have been saved in the cost of new equipment, and special articles are made to suit their own particular needs and requirements that are otherwise unobtainable.

Judging by other standards, the Hospital Ste. Justine is not a large one; it is probably one of the smallest because adults are not treated there, although there is a special department for maternity cases. One wonders, therefore, why the same experiment has not been made by some of the larger institutions, whose requirements are much greater for such articles as bedsteads, cots, stretchers, food wagons, and cabinets and many other articles for kitchen and other uses, all of which could very easily be made by any competent welder out of such material as light angle iron, piping and sheet steel. By the use of lighter material such as steel tubing, aluminum or other alloys, a considerable saving in weight could probably be effected, as this is very desirable in a hospital when the articles have to be moved around by the nurses, without greatly increasing the cost of the article.

Much of the equipment used in institutions of this kind is not made in Canada, but has to be imported, and to its initial cost must be added duty and freight. While it may be conceded, therefore, that an establishment cannot manufacture as cheaply as a manufacturer working on production, there is nothing to be added for profit and other expenses and therefore the net saving is a very appreciable item—sometimes as much as 50 per cent of the catalogue price alone. This is good food for thought by any one who buys equipment of the variety and quality required in a hospital or other similar institution. It is also evident that a great deal of repair work has to be done at times and what could be better than to have a welding department available for the purpose?

Welding the 18-8 Alloys

By G. Van Dyke†

ALLEGHENY Metal is a Chrome-Nickel Iron Alloy containing approximately 18 per cent chrome, 8 per cent nickel and small amounts of Manganese and Silicon. The carbon in this alloy will vary from 0.15 to 0.06, depending on the class of work for which it is to be used, and also the method of manufacture by which it is to be fabricated.

Because this particular type of alloy lends itself readily to welding by the electric, gas or spot processes, its production has opened up a large field of application which was barred to other of the so-called "Stainless Steels" because they could not readily be welded.

Of all the various analyses of "Stainless Steel" which have been produced, the 18-8 type is the most useful, and finds the widest application not only because of its weldability but because it presents the greatest resistance to the greatest variety of corrosive attacks.

In determining the value of any corrosion resisting alloy for a certain application, the metal should not be called upon to resist all types of corrosion, but rather should the question be raised as to whether the metal is sufficiently resistant to corrosion to satisfactorily take care of the particular job which is under consideration.

The corrosion resistance of an alloy depends not only on its composition but also on the care taken in its manufacture and upon its structure. Bearing this in mind, it is very important that the welding of this alloy should be done in such a way that neither the analysis nor the structure of the metal will be changed; and for this reason, the chemistry of the flame in gas welding is of vital importance.

The first consideration in gas welding Allegheny Metal is to get the proper mixture of acetylene and oxygen. If an excess of oxygen is used, it will burn up or oxidize a considerable portion of the chromium, and this not only changes the analysis of the metal but produces oxides of chromium which will cause the metal to boil and produce welds which are porous and of low corrosion resistance value. If an excess of acetylene, which is a compound of hydrogen and carbon, is used, the molten metal will absorb a certain amount of the gas and the carbon content of the weld will thereby be raised. This increase in carbon content is very detrimental to the corrosion resistance and produces a brittle weld.

From what we have said it would appear that an exactly neutral flame with neither an excess of acetylene or oxygen would be desirable, and if it were possible to get such a flame, it would probably be ideal. In actual practice, however, the flame should be adjusted so as to give a very slight excess of acetylene which is indicated in the flame by very short "feather tips" on the end of the combustion buttons. The torch should be held as close to the metal as possible, so as to push the flame down into the weld; and the rod should be held above the weld so that it will melt and drop down as you go along. Puddling should be avoided, as it tends to produce a porous weld. If the flame is properly adjusted and sufficient heat is used, the Allegheny Metal rod will melt freely and will drop down in clean drops. For those who like to use a flux, I recommend the product of the Oxweld Acetylene Company, known as "Chromaloy" flux, which has a tendency to make the metal flow a little more freely and is of assistance in securing deeper penetration.

I would recommend the use of a tip one or two sizes smaller than would be used on the same gauge of steel and in most cases, about five pounds pressure on both acetylene and oxygen will be found sufficient. It is essential that accurate regulators be used so that a uniform mixture can be maintained continuously.

NOTE PENETRATION OF WELD ON REVERSE SIDE
METAL MADE BRITTLE BY EXCESS OF ACETYLENE
POROUS WELD CAUSED BY EXCESS OF OXYGEN
TO GAUGE ALLEGHENY METAL BENT FLAT AFTER ELECTRIC WELDING
CORRECT ACETYLENE AND OXYGEN MIXTURE
3813

Examples of Various Methods of Welding Allegheny Metal and the Results that May Be Expected

In electric welding Allegheny Metal by the metallic arc process, it is important that the rod be of the right analysis and that the coating on the rod be of such a character that it will produce sound welds, deep penetration and a bead of equal corrosion resistance to the parent metal. The production of and coating of the rods is a technical matter which is best left to the manufacturers of the metal, and if any good operator will bear the points mentioned in this article in mind, he will be able to produce a good job.

In the first place, reversed polarity should be used. That is

†*Manager, Special Steel Department, Joseph T. Ryerson & Son, Inc.*

to say, that the electrode should be connected to the positive pole of the generator and the work or ground connected to the negative pole of the generator. It is well to use rather less power than would be used on a similar gauge of steel, although this is a point which is best worked out by each operator himself. Some men can weld more rapidly than others and, therefore, can use a greater amount of heat. After a little experience each operator will find the best voltage and amperage setting for his particular machine on various gauges. A welding outfit should be provided which has very flexible controls because variations in voltage and amperage are rather critical on this alloy. A short arc should be used, partly because it will give a more uniform penetration, and partly because with a short arc there is less chance of the molten metal becoming oxidized and thus producing porous welds. Backing up is to be recommended where possible, and in each case the operator should be provided with samples on which to experiment for power adjustment and arc length before he starts on any job.

The scale produced on these welds is usually heavy and hard, and it would be found very helpful if the scale is ground off the bead left by one rod before starting the continuation of the weld with the next rod.

There are certain general principles concerning all types of welding on Allegheny Metal. In the first place, when this metal is heated to any temperature in excess of about 450° Fahrenheit, it will discolor or oxidize on the surface. This oxidization must be entirely removed as it will rust rapidly, and the rust will spoil the appearance of what might otherwise be a very good piece of work. Oxidization can be removed by grinding, or can be taken off by the application of a mixture of one part of commercial nitric acid to one part of commercial hydrochloric acid. This acid mixture is extremely powerful and should only be left on the metal for a sufficient length of time (probably a few minutes) to remove the discoloration. It is absolutely essential that every trace of the acid be removed from the metal first by washing with water, and then following this, by a thorough washing with soap and water in which has been dissolved some Sal Soda, ammonia or other alkali.

If Allegheny Metal is to be used to resist severe corrosive attack, then it is essential that it should have the right metallurgical structure. This term meaning that the carbon should be in solution in the iron and not in the form of carbides which are chemical combinations of iron and carbon.

It is unfortunately true that metals of the 18-8 type if heated to temperatures within the range of 950° to 1550° Fahrenheit, will during certain periods of time, and depending on the temperature, undergo a structural change in which some of the carbon will be precipitated from solution and be converted into an iron carbide, or perhaps an iron chromium carbide. These carbides accumulate along the grain boundaries of the metal, and if the metal is then subjected to heavy corrosive attack such as nitric acid, hot salt water, copper sulphate solution and so forth, an electrolytic effect may be developed which will destroy the metal.

It is obvious that in welding, the metal is at some point heated to these temperatures and, therefore, there is always an area adjacent to the weld which will have a lower corrosion resistance than the parent metal. This carbide precipitation does not occur instantaneously, but requires a certain amount of time to develop. It is obvious that because a No. 24 gauge sheet will cool more rapidly than a ¼ in. plate, that precipitation is less likely to occur in light gauge work than in heavier thicknesses. It is also true that experience has indicated that in applications such as soda fountains, restaurant equipment and so forth, corrosion is of such a mild type that carbide precipitation need not be considered. On the other hand, the calcium bi-sulphide solution used in the sulphite paper industry is so highly corrosive that all welds must be treated to eliminate carbide precipitation. Between these two extremes each application must be considered from the standpoint of the degree of corrosion and also the probability of carbide precipitation which in turn is governed by the technique of welding and also the thickness of the parts which are welded.

It should be noted that where carbide precipitation has occurred, that it can be eliminated by heating the metal to a temperature of about 1950° F., which heating should be followed by a cooling sufficiently rapid to prevent further precipitation. The method of cooling will, of course, depend on the thickness of the section and the details of such operations should be discussed with the manufacturers of the metal.

Metals of the 18-8 type will expand when heated about 50 per cent more than steel, and the heat conductivity is only about one-half that of steel. These two factors tend to make the metal warp more than steel and this point must be taken into careful consideration in all welding jobs. Jigs must be used to hold warpage within practical limits.

Welds in Allegeheny Metal are extremely tough, and any welds made on metal about No. 10 gauge or lighter should stand bending flat on themselves without fracturing.

Welded Pipe Replaces Riveted Angles

The possibility of substituting a welded tubular structure for a riveted structure of conventional structural shapes has been carefully investigated in Germany, and this application of welding is gradually being extended into a number of interesting fields. A particularly interesting one is shown in the accompanying illustration of a new type of diving tower. This is about 30 feet high and the frame work consists entirely of steel pipe welded together by the oxy-acetylene process. The shape of it immediately suggests the possibility of adapting this type of assembly to a wide range of uses.

Annealing Furnaces Built at Low Cost

This Piece of Equipment Can Be Fabricated by Welding From Scrap Materials and by Its Use Welding Operations Increase

By F. W. Graneman†

THE American Railway Association Code of Rules requires that such parts of railroad cars as spring or bolster hangers, cast steel truck sides, pressed and structural steel truck sides, bolsters and transoms, cast steel bolsters and cast steel coupler yokes, must be carefully annealed after welding by uniformly heating to 1,400 or 1,500 degrees Fahrenheit and allowed to air-cool slowly in the atmosphere. Industrial plants as well manufacture a great variety of parts which require thorough annealing after welding. To properly perform this work, annealing furnaces are indispensable.

Railroads have effected great economies and increased their operating efficiency by equipping more shops along the line with annealing furnaces. Work which requires annealing is handled at various points and the loss of time and expense incurred in shipping it to a given location for execution is avoided. With more shops fitted to perform additional welding operations the benefits which accrue to the railroads from more extended use of this money-saving process are multiplied.

Industrial plants, by installing annealing furnaces, have increased their scope of operations and taken on additional lines of products. Profits have been augmented through greater output, and quality of product is improved by proper heat-treatment.

For a long time our Applied Engineering Department men urged one railway company to install annealing furnaces in various shops along their line, but work was delayed as the necessary appropriation of about $1,200 per furnace was not forthcoming. Finally our Applied Engineering Department men offered to build a furnace of scrap material and bricks at a cost not to exceed two or three hundred dollars. This suggestion was accepted and carried out and was found to be not only practical but to increase welding in the car department at that point to at least double the former amount. Since then, two more annealing furnaces have been built in other shops with the same result and authority has now been obtained to install three additional ones.

Furnaces Built

The first furnace built is illustrated in Figs. 1 and 2. Fig. 1 is a view looking into front of furnace, door raised. A rear view of furnace, showing combustion chamber, oil burner and external appearance is afforded by Fig. 2. Fig. 3 is a general arrangement drawing of furnace, giving constructural details and dimensions. A second furnace was installed at another point of the same size.

At a third point we recently completed an annealing furnace built along the same lines, but somewhat larger, to accommodate certain types of automobile car body bolsters. Approximate inside dimensions, exclusive of combustion chamber are;

†*District Supervisor, Air Reduction Sales Company.*

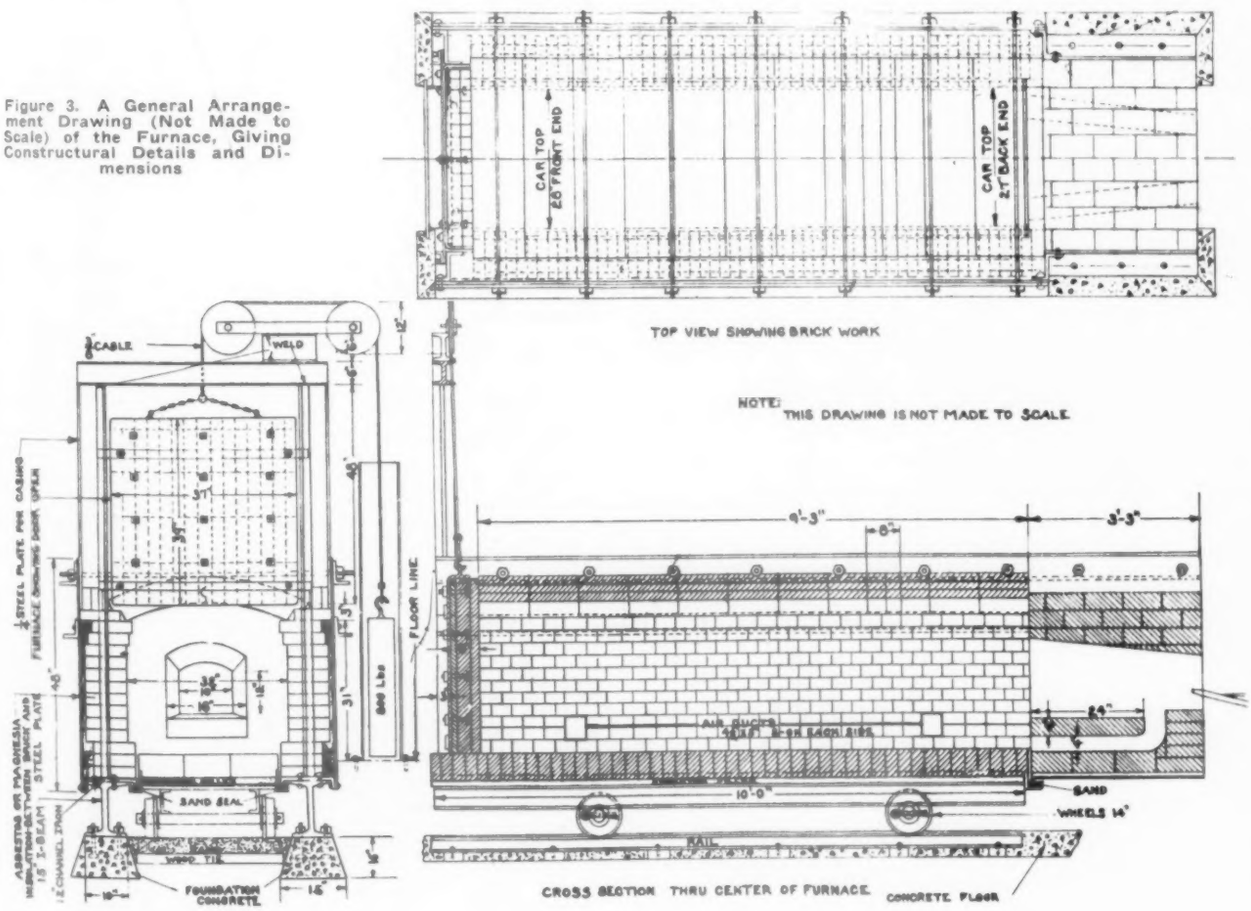


Figure 3. A General Arrangement Drawing (Not Made to Scale) of the Furnace, Giving Constructural Details and Dimensions

Length 11 ft., width 40 inches, height 33 inches from top of car to highest point of arched roof. The combustion chamber is about 3 ft. in length and tapers with small end toward the rear, where oil burner is located. This furnace will anneal about five truck sides or about four bolsters in one heat.

Steel Work

In constructing an annealing furnace the first step, after deciding on a convenient location, is to make level concrete foundations with embedded foundation bolts to hold the main "I" beams forming the base. These "I" beams are 12 to 15 inches high and run the full length of the furnace, including combustion chamber.

Channel irons (about 12 inch) of same length as main part

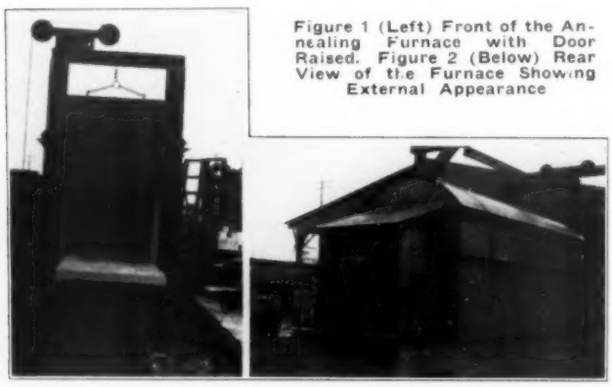


Figure 1 (Left) Front of the Annealing Furnace with Door Raised. Figure 2 (Below) Rear View of the Furnace Showing External Appearance

of furnace are laid on tops of "I" beams, with flanges protruding downward. The inside flanges of channel irons run in troughs on car and form part of sand seals. The side sheets of furnace are bolted to the outside flanges of channel irons. "Z" iron uprights are welded to the tops of channel irons.

The car is next constructed and the track laid, adjusting the latter to the proper height for flanges of channel irons to run freely in the sand troughs along sides of car. Both car and furnace are usually made from ½ inch to 1 inch wider at front or door end so that car will have no tendency to bind when pulling out of furnace. Furnace casing side and rear sheets and combustion chamber casing sheets, of ¼ inch thickness, are now bolted in place. These sheets are reinforced with angle irons (see Fig. 2), properly spaced and held firmly at top with tie rods. A ¼ inch thick hood is also placed over top of oil burner, as shown in Fig. 2. The base of combustion chamber is formed by a sheet of heavier material placed across tops of "I" beams.

Furnace top or roof covering is made from ⅛ inch steel plates. Rounded portion over main part of furnace is rolled to proper contour and bolted to ribs, or roof beams, the latter being also curved to shape and welded at ends to side sheets and top angle irons.

Welding and cutting is used to a considerable extent in constructing these furnaces. In the case of railroad shops, much of the steel required can usually be made from second-hand or scrap material, picked up locally, and the cost of the furnace is reduced accordingly.

Brick Work

After completing steel work, bricking is started, using standard firebrick laid end-wise for the side walls, making wall-thicknesses equal to the length of the brick. A lining of sheet-asbestos, ½ inch thick is placed next to steel sheets. Arch-brick is used for the top of the furnace. Both the door and the top of the car are also lined with asbestos and bricked with bricks set on edge to give wall-thickness of width of brick, or about 4½ inches. All bricks are dipped in a thin solution of furnace cement for a binder. The chief labor item is usually for bricking as it usually requires several days for a bricklayer and helper to complete a furnace.

The total weight of the door is about 700 lb. and a scrap locomotive axle, or other suitable weight, may be used as a counterbalance.

Various types of oil burners are used, ordinarily made up locally. Heavy fuel oil was burned at first but was not satisfactory in cold weather unless steam for heating it was available. Lighter Diesel oil is now used instead. Large size burners from rivet forges have also been used with some success.

Large Electric Welded Water Line Complete in So. California

The San Diego (California) municipal water line, which was under construction last year, has recently been completed and will soon be in use. The line is about 20 miles in length, the greater portion of which is of 40-inch steel pipe, and is all electrically welded.

The accompanying photographs furnish some interesting views of this large line taken during the time of its construction.

Figure 1 shows a truck-load of four of the 30-foot lengths of the 40-inch pipe, being transported for use in the line. The comparative size of the pipe is here easily realized.

Figure 2 is a view of the line as it emerges from one of the tunnels of which there are four in number, through which the line passes on its way from Otay Reservoir to the city limits. This tunnel is almost a half-mile in length.

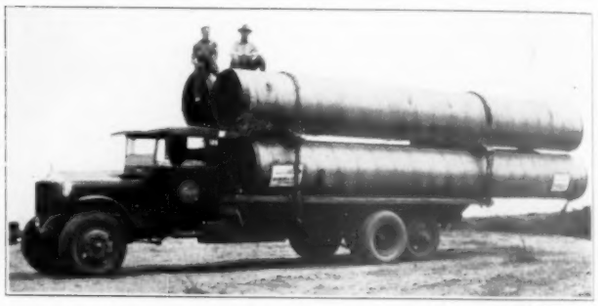


Figure 1. Hauling a Load of the 30-Foot Lengths to the Job

Figure 3 is an interior view of Tunnel No. 4 of the line, showing the method of laying the line in the tunnels. The 40-in. steel pipe is seen as it is being installed temporarily on a succession of dolly trucks. As each additional joint of pipe is attached and welded, it is pulled into the tunnel. Results of this procedure were very satisfactory. Out of abundant caution, the joints for these tunnels were all welded both inside and outside. Note the figure of a welder seen through the inside of the pipe a considerable distance away.

This all-welded water line was completed by the Western Pipe and Steel Co., of Los Angeles, under the direction of Mr. H. E. Robinson, Superintendent, and the project was supervised for the city of San Diego by Mr. H. N. Savage, hydraulic engineer.

Figure 2. (Left) The Line Emerging from One of the Four Tunnels. Figure 3. (Right) Inside One of the Tunnels Showing Method of Running Pipe on a Series of Dolly Trucks.

Control of Spot and Flash Welds*

Discussion of Electrical Characteristics of the Equipment and Tests Which Show Results Obtained in Resistance Welding

By G. A. Hughes†

Electrical Characteristics of the Spot Welder

IN a single-spot spot welder with a deep throat such as a standard manually operated welder, the conductors carrying the heavy welding current parallel the iron and of course increase the inductive reactance. As the current is passed through the sheet or work being welded, a choking effect is produced, depending upon the distance the sheet is inserted in the throat of the machine. This is very noticeable in welding the seam of a cylinder. The greater the number of square inches of iron enclosed in the welding circuit the greater will be the reactance. This is what causes the poor power factor of a spot welder. This power factor can be improved if two spots are made at the same time. This is accomplished by using two transformers with primaries in parallel and secondaries in series. The secondary leads are shortened and placed on the same side of the work outside the magnetic loop, also the number of square inches of iron in the welding circuit are cut to a minimum.

The power factor on single-spot machines manually operated will depend upon the work and somewhat on the design of machine, ranging from 35 to 50, while on two-spot welders it will range from 58 to 84. The power used in KW for making single-spot welds on two pieces of 3-16 in. plate will vary, of course, with the time, usually between 20 to 30 KW with a power factor which will vary with work, usually between 35 and 50, time from 4 to 15 seconds, making a 3-8 in. diameter spot. Pressure at electrodes used to heat material is about 50 lbs. per sq. in. Pressure used to force material together is 700 lbs. Current in this weld is approximately 8000 amperes. Automatic welders make the spot in from .3 to 1 seconds using 75 to 100 KW.

An integrating watt hour meter was installed on an automatic spot welder welding two pieces of 16 ga. to 14 ga. to determine the amount of KWH consumed per weld. Size of spots was about 1-2 in. x 3-16 in. In a day's run of 10 hours a little more than 18,000 spots were made, with a total of 389 KWH consumed.

The accuracy of integrating watt hour meters recording the power consumed by welders have been questioned by many engineers, giving for their reason that, for the short period involved, the integrating wattmeter is sluggish and will not respond quickly enough. On the other hand other engineers claim that the deceleration of the meter disc will compensate for the slow acceleration.

It is the writer's opinion that proof cannot be obtained by either claim by using the ordinary method of meter checking and testing. Take for instance, a familiar type integrating watt hour meter, single phase. The full load speed of the disc is 25 R. P. M. Assuming 200 volts and 300 amperes and a period of welding time of 1-5 sec. a 30 KW load the meter disc will make about 1-19 revolution. The error in taking readings with a volt meter and ammeter will be too great to act as a check.

The size of the power transformer for a welder load is very important. Experience has shown that where more than one machine is used it is not necessary to install transformers whose KVA. rating is equal to the total KVA. rating of the welders. The load will vary from a fraction of a second to a few seconds depending upon the nature of the work. To determine this factor a series of tests was run on six circuits carrying only a welder load. The total KVA of three welders on a circuit working on light stock but large and difficult to handle was over 90 KVA. while the averaging high KVA. consumed with 41, giving a factor of 45.5 per cent. Another

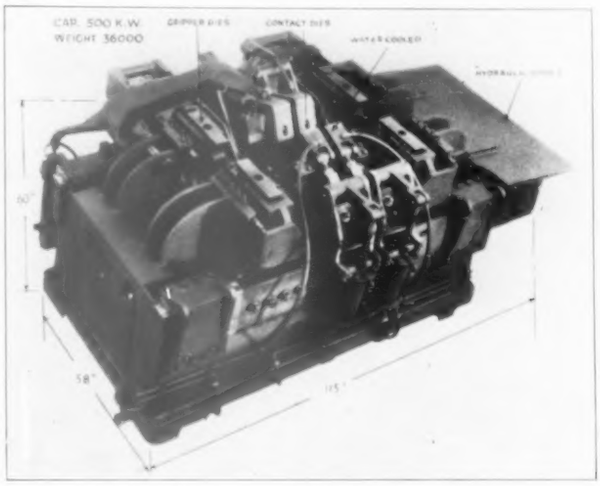


Figure 1. Front View of a Pipe Welder with a Capacity for 2- to 8-Inch Pipe.

circuit carrying two welders, one being semi-automatic, with a total rated KVA. of 110, working on heavy stock but easily handled, showed an average high load of 73 KVA. or giving a factor of 66.3 per cent.

Another circuit having six welders with a total of 190 KVA, all of which were working on light stock and easily handled, showed an average high load of 107 KVA. showing a factor of 56.4.

These tests show that where several welders are installed the transformer KVA. capacity should be about 66 per cent of the total rated KVA. of the welders.

The first spot welding in the structural steel field was by the Truscon Steel Company in March, 1915, when they built a box column from channels, using spot welding instead of rivets, for their standard steel buildings. They were the pioneers in using spot welding for their roof trusses and floor joists. These have stood the tests for over fifteen years and now their strength and reliability are unquestioned.

Only recently the Bureau of Standards made quite elaborate tests on spot welded girders and columns, using the button type of spot welding and tested them with riveted girders and columns. The conclusion drawn from these tests shows practically the same strength with a little (if any) in favor of spot welds.

Some tests were made to see what effect spot welding had on the chemical analysis of sheet. A piece of 1-2 in. plate was cut and spot welded together and sent to the chemical laboratory for analysis.

The following report was received:

1. From center of weld. Sul., .038. Phos. .020; Mang., .59; carbon .08.

*From a paper presented at a joint meeting of the Association of Iron and Steel Electrical Engineers and Pennsylvania State College, 1931.

†Electrical Engineer, Truscon Steel Company, Youngstown, Ohio.

2. From edge of unwelded section but affected by heat; Sul., .042; Phos., .019; Mang., .60; carbon, .08.
3. From plate unaffected by heat: Sul., .040; Phos., .021; Mang., .58; carbon, .08.

In making the weld in this plate approximately 12,000 pounds pressure was used on the electrodes. Current was approximately 60,000 amperes; time six seconds, diameter of the tip of electrodes 5-8 inch, ultimate load 41,300 pounds.

Figure 2. Typical Flash Welds Made in 6- and 8-Inch Pipe.

For ideal spot welding conditions, plates should be very close to the following analysis:

Carbon	.25 or less
Manganese	.40-.80 Maximum (some question)
Phosphorus	.025 or less
Sulphur	.025 or less
Silicon	Low as possible

Some engineers say difficulty is encountered in welding when carbon plus manganese is more than .80. In all cases investigated where carbon plus manganese was over .80, phosphorus, sulphur or silicon were extremely high; and in many cases investigated when difficulty in welding was encountered, carbon and manganese were less than .70 but either sulphur, phosphorus or silicon were high. So the writer is inclined to believe that sulphur, silicon and phosphorus are the elements causing difficulty.

In an effort to determine the safe load of a spot weld elaborate tests were made several years ago. Over 1,000 pieces of various gauges were welded, having from one to three spots. Two hundred pieces were sent to Carnegie Institute of Technology at Pittsburgh. These tests were for shear and pulled at 1-8 inch per minute. It was found that the welds varied from 2,990 lbs. minimum per spot to 8,815 lbs. maximum for 14 ga. using a 5-16 in. electrode. A careful study was made of the nature of failure of the welds and more tests made and data taken to discover just why this variation. In all cases, the failure was in the weld being pulled from the sheet.

The periphery of the welds was nearly uniform but the thickness of spot varied. This, no doubt, was caused by having some spots heated to a higher temperature and more metal was forced out when the pressure was applied at finish of weld. The periphery of weld multiplied by the thickness of spot gave a difference of metal to be sheared at failure of weld. This difference of volume of metal was the cause of variation in pounds of failure of welds.

Elaborate tests were then made to determine the relation of shearing of a spot weld or flash weld to the shear of the parent metal. This was found to be 93%. The relation of tensile strength to tensile strength of parent metal was also 93%. All of our tests were made on open hearth steel, carbon less than .40.

Flash Welding

The question whether there is a true arc during the flash in flash welding operations is debatable. There are many engineers who believe a true arc is not established and there are others who believe that during certain moments of the flash, the current is conducted by the electric arc and not by the solid or liquid metal.

Arc welding with a few hundred amperes is not a parallel case to flash welding where the current is many thousand amperes. Here the flash welder is operating under different conditions than when the current is small.

Here we have an electric arc in an atmosphere composed entirely of iron vapor. As the ionizing potential of iron is 7.4 volts and the open circuit voltage of the flash welder is 14 volts, the conditions are such that it is possible to establish a true arc.

During the continuous flash there are surges of voltage and at certain moments the peak voltages may attain values sufficient to establish a true arc in an atmosphere of pure iron.

The true arc is not continuous and persists only during short intervals of time, a fraction of a cycle. The balance of the time the current is conducted through molten metal. The flashing is a combination of resistance and arc conduction of the current.

The flash method of butt welding is much faster than the upset butt method, requiring about one-eighth the time and at about one-half the cost.

Design of the Flash Welding Machines

In designing a butt or flash welding transformer, the secondary leads are made as short as possible and are usually cast copper and water cooled. One side of the secondary is

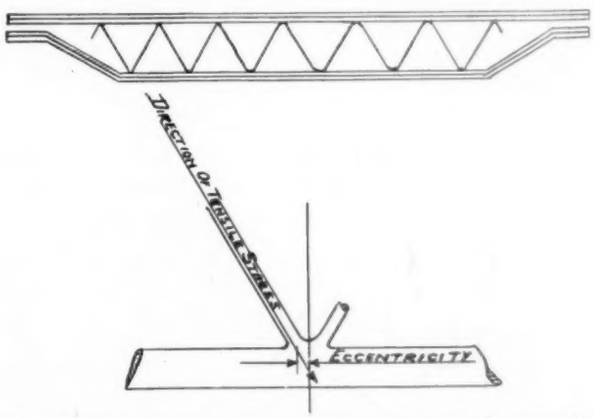


Figure 3 (Above). Truscon Steel Company Bar Joist with Web and Chord Connections Resistance Welded. Figure 4 (Below). Method of Testing These Connections.

bolted to one of the clamping devices. The other side of the secondary is connected to the other clamping device by a very short flexible copper conductor. The voltage on the secondary is varied from approximately 8 to 14 volts by means of an auto-transformer in the primary of the transformer. The transformer is air cooled, single phase, 25 or 60 cycle and 220-440 or 550 volts. The power factor of a flash welder is higher than in a spot welder, running from 80 to 91 depending upon the size of the welder.

Efficiency

The manufacturers of Flash or Butt Welders guarantee their machines to be capable of welding a certain number of square inches cross section in a given time; also their spot welders of being capable of welding a certain thickness of material, with a given diameter of electrode in a given time. These are maximum capacities, but a manufacturer purchasing a welder will change the clamping devices on flash or butt welders to suit his product and we find all welding equipment operating a large part of the time at reduced capacities and of course at reduced efficiencies. Even at maximum capacities the resistance welder is not an efficient electrical machine. The transformer is designed for a very large current and low voltage. The secondary terminals are bolted to the iron of the machine for mechanical strength for the welding clamps and the secondary is parallel to iron and partly surrounded by iron. This causes a loss of efficiency owing to the heavy alternating current paralleling the iron. Also all secondary windings of welding transformers are cast copper, which does not have the conductivity of hard drawn copper and increases the transformer losses as the I^2R is high. The above is true of all resistance welders, there being at least seven joints or connections in the secondary circuit not counting the joint between the work. This heating of the connections represents power loss and must be charged against the overall efficiency of the welder as the heat is not utilized in the weld. About 50 per cent is lost in the welder itself. However, this poor efficiency of the welder is not alarming, as a test on a flash welder welding 20 square inches showed a consumption of 545 K.W. of energy during the flashing period of 23 seconds. This represents a very low cost per weld.

No definite data can be given as to power required to make a butt or flash weld. The present idea of mass production with the cost clerks and efficiency department howling for lower costs and greater production all tend to speed up the welding operation. Forty K.W. used to be sufficient to weld one square inch on a manually operated flash welder in the "good old days". Since the power to weld is dependent on time, and as speed is the watchword of today, we find 80 K.W. now too small. One job of welding is reported as using 100 K.W. for one square inch. Welding time, six seconds. Fig. 1 is a modern type flash welder for joining lengths of pipe and Fig. 2 shows a couple of welds made on this machine. These photographs are supplied through the courtesy of the Federal Machine & Welder Co., Warren, Ohio.

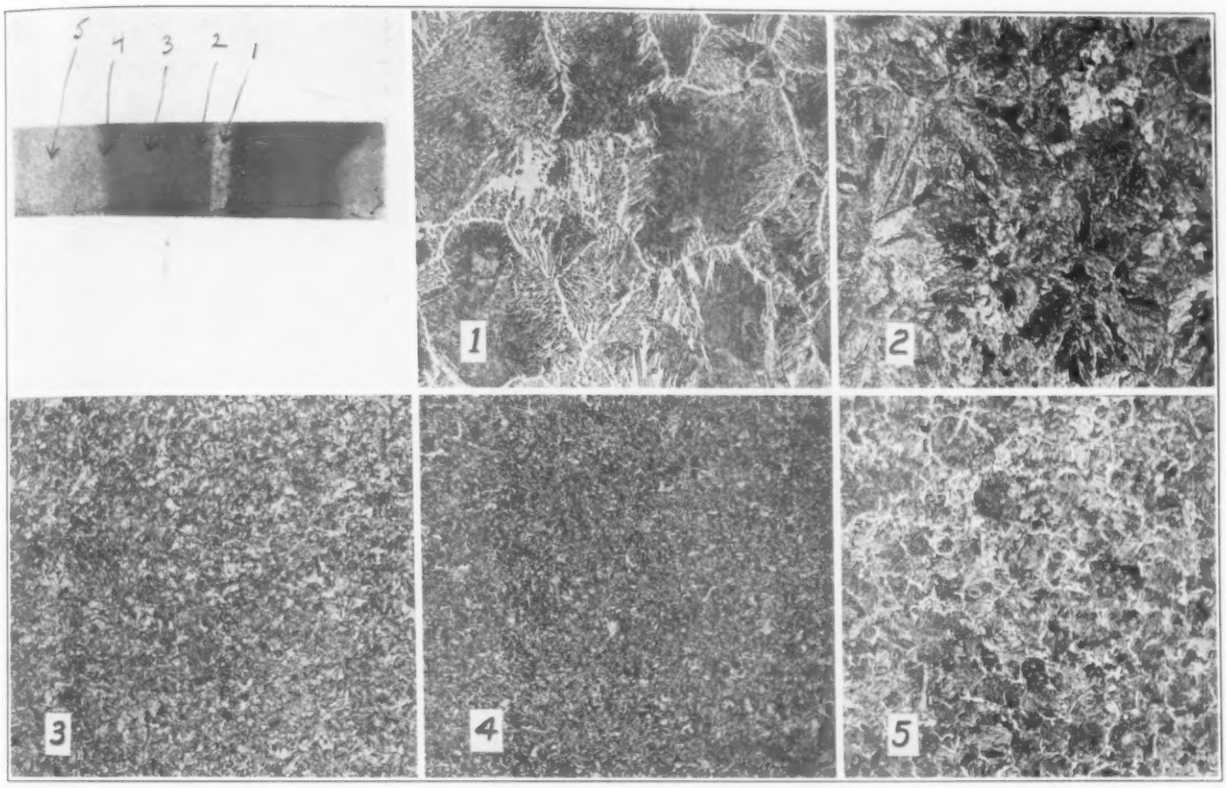


Figure 5. A Resistance Weld Specimen in Steel Containing .50 Carbon and .53 Manganese, Ground, Polished and Etched for Photomicrographs at the Points Shown. The Photomicrograph Numbers Correspond to Those on the Specimen.

Strength of Butt Welds

Table I shows results of tests made at Lehigh University during the Welding Symposiums for 1927-28-29 and 30. The

TABLE I
Summary of Results of Tests on Resistance-Butt Welded Joints Lehigh University Welding Symposiums

Date	No. of Specimens	Dimensions	Stress lbs. sq. in.	Remarks
April 4, 1927	1	⅞"x⅜"	61,600	Broke 2" from weld
	1	⅞"x⅜"	63,780	Broke 4" from weld
April 16, 1928	? (Probably 3 or 4)	½ diam.	76,230	Av'ge stress All broke outside of welds
April 8, 1929	1	.....	74,800	
	2	½" or ⅝"		Av'ge Torque 4,600 lbs.
	2	unwelded (for comparison)		Av'ge Torque 5,700 lbs.
		Approximately:		
April 11, 1930	1	1½"x½"	80,600	Area
	1	1½"x½"	77,400	reduced to
	1	1½"x½"	74,700	force failure
	1	1½"x½"	77,600	in welds

Cold Bend Ductility tests on 3 specimens yielded 27 per cent, 33 per cent and 26 per cent, respectively.

upset was machined to size of the test specimens. In 1927 one specimen failed 2 inches from weld at 61,600 lbs., the other failed 4 inches from weld at 63,780 lbs. Stock in both specimens were the same. Still there was a difference of 2,180 lbs. If a third had been tested it is possible for it to have failed in the weld at 63,000 lbs. This would have given over 100 per cent in comparison with specimen No. 1 and less than 100 per cent in comparison with specimen No. 2. Yet both specimens show 100 per cent strength of weld. This variation of maximum tensile strength of parent metal makes it very difficult to obtain a relation of maximum tensile strength of weld to maximum tensile strength of parent metal. However, an average of over fifteen years of tests leads us to estimate 93 per cent as previously stated.

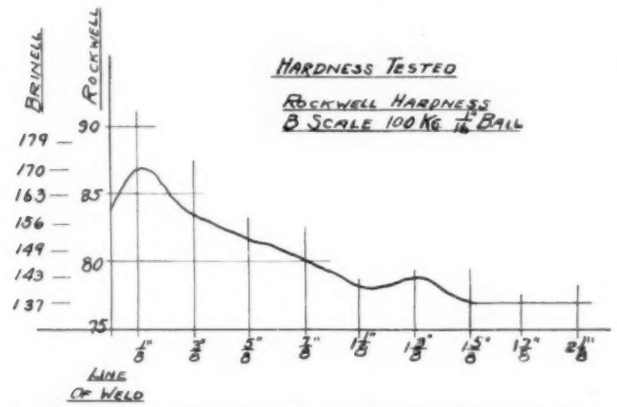


Figure 6. Comparative Brinell and Rockwell Hardness Tests Made on Resistance Welds in Low Carbon Steel.

Figure 3 shows a Truscon Steel Co. bar joist. Connections of web to chords are resistance welded. Fig. 4 shows a method of testing one of these connections.

Chord Section	Web Bar Rd.	Average Load Failure Lbs.	Area of Weld	Max. Tensile Stress in Weld	Unit Shear in Weld	Unit Tension in Web Bar
423	7/16	7,160	.260	64,200	13,450	47,600
424	1/2	8,770	.298	65,600	14,700	44,750
424	9/16	11,645	.343	73,200	17,000	47,200
426	5/8	13,440	.392	70,500	17,200	43,900
427	3/4	16,210	.515	64,200	15,700	36,700

In testing the resistance weld of web to chord member, the flanges of the chord section were cut away to permit gripping in the test machine and tension was applied to one of the diagonals.

The weld is an ellipse and when tested in this manner is subjected to both tension and shear. The web bar is continuous and formed by bending the smaller sections around a ½ inch diameter pin. The larger size web is bent around a 1 inch diameter pin, is curved adjacent to the weld, with the result that the center of the tensile stress is eccentric with regard to the weld. By calculating this eccentricity and determining the area and amount of inertia of the elliptical weld it is possible to determine the maximum fiber stress in the weld area due to direct tension and bending. The maximum tensile strength given is the sum of the unit stress due to tensile component and the maximum fiber stress resulting from bending. Each result is an average of many tests. At least 95 per cent of the failures were in the web.

These results cannot be taken as strictly accurate, as there is considerable uncertainty as to the exact areas and eccentricities, but they undoubtedly approach the truth closely and indicate that the weld metal is sound, low carbon (about 0.18) steel of normal properties.

A series of tests were made on steel bars with carbon varying from .10 to .80. Bars were flash welded and weld ground to ½ inch diameter for a distance of two inches each side of the weld. Tests were pulled at ⅛ inch per minute. Following are a few of the results obtained from an average of four tests.

Car.	Mang.	Phos.	Sul.	Yield lbs. sq. in.	Ultimate lbs. sq. in	Elongation % 2"	% Reduction areas
.15	.49	.016	.029	36,990	59,190	35	42
.35	.50	.013	.027	51,020	83,160	27	30
.50	.53	.017	.022	69,900	101,000	10	08
.70	.55	.018	.033	103,100	140,500	....	....

All tests broke outside of weld and at values slightly less than the maximum strength of an unwelded bar. When weld is at 90° to the fiber of the test piece, weld pulls less than an unwelded section. If weld is 15° to fiber, weld is stronger than unwelded section.

A weld in steel containing .50 carbon and .53 manganese was ground, polished, etched and photomicrographs made. Fig. 5 shows an etched section near the weld and microphotographs at points 1, 2, 3, 4, 5 indicated. Point 1 is in the weld itself and point 5 is about ⅛ inch from point 1.

A Rockwell test was made at points photographed (each zone) on B Scale ⅛-inch Ball 100 K. G.

Point No. 1—weld	80.5
No. 2—	98.
No. 3—	95.
No. 4—	87.
No. 5—unaffected by heat	80.5

Another test of butt welding of low carbon open hearth steel was made on ¼-inch stock. Test specimens 4 inches wide were cut after welding. This gave 1 sq. in. in area. Weld did not fracture. Stock showed a maximum tensile strength of 54,260 lbs. per sq. in. Chemical analysis—C. .12; Man. .56; Phos. .012; Sul. .023; Sil. .011. Figure 6 shows Brinell and Rockwell tests.

Large Electric Welded Gas Line in California

One of the major pipe line construction jobs of Southern California in 1930 is shown in the accompanying photographic views taken at different times and places along the route of the line. The size of this line, which is all electric welded, is 22 inches for the greater distance, and was laid for the Southern California Gas Company of Los Angeles, which company furnishes a major portion of the gas supply for the city of Los Angeles. The line runs from the gas fields near Taft, Calif., to the company's terminal meter station at Santa Monica.

The line is 66 miles in length, the greater portion of the distance traversed being very rough. Many deep canyons and

Figure 1. View of the Line Approaching "Tunnel Ridge". Note the Irregular Contour of the Country Which This Line Traverses

Figure 2. A Double Bell Pipe Weld in the 66-Mile Line. Figure 3 (Inset) An All-Welded Suspension Bridge

precipitous embankments were encountered over the portion of the route known as "The Ridge," which is a range of mountains running north of Los Angeles, which made some "rough going."

Figure 1 furnishes a view of the line approaching what is called "Tunnel Ridge," and shows the general contour of the country over which the line is laid.

Figure 2 shows a double bell pipe with a weld prominently in evidence in the front of the picture. This photo shows some rough going thru what is known as Sepulveda Canyon.

Welded expansion joints of corrugated steel were used extensively in the line, not only to take care of contraction and expansion, but also to relieve strains at irregularly supported points in the line. These expansion joints—more properly known among pipe line welders and construction men as "wrinkle bellies"—are also used as a practical and convenient method of making bends.

Figure 3 is an all-welded suspension bridge, or "overhead," for supporting the pipe line across a 50-foot cut in the mountain, thru which the highway passes beneath. Note the welded pipe and braces supporting the suspension cables. The welding work of this line was directed and handled by the A. O. Smith Corporation of Milwaukee, Wis., which company also furnished the pipe for the line. Lining and back filling was by the Macco Construction Company of Long Beach, Calif.

Training Welders for Industrial Work

By C. D. Moore†

IN A PREVIOUS article published in this magazine an outline was given of the procedure followed by the Westinghouse Electric & Manufacturing Company in training welders in the school. Of course, anyone who understands welding and its many divisions and applications will know that the experience gained in the welding school is only the beginning, and that many things have yet to be learned before the welder can be considered a skilled workman.

Therefore, we are giving here the continuation training program for welders as it is conducted for men in our own plant.

In order that the student may learn the art of fusing metals, it is necessary that he be placed under conditions that are as nearly ideal as is possible so that he may give his entire attention to the operation itself. For this reason, the school is equipped so that the student may sit in an easy position during the preliminary training, and will not be required to change positions to any great extent. His mind and body, of course, become trained to work under these conditions. Each student is enclosed in a separate booth where he can devote his entire attention to his work. He is not bothered by the moving of material about him on the floor, nor by cranes conveying loads overhead, neither is he annoyed by the flash coming from other welders working close to him.

Because of the favorable conditions in the school the fundamentals of welding may be taught very thoroughly, and the student may acquire a good knowledge in the theory of welding. After he has completed the course of instruction given in the school, he is placed in the shop as a regular welder, but is allowed to work only on the easier jobs. As he acquires skill and experience he may be advanced to higher class work.

For at least two months after the student has been placed as a regular workman, he follows a prescribed course of training somewhat similar to that of the school except that he works on actual productive work. The foreman of the welding school makes daily visits to each welder and gives special instruction on whatever kind of work the man may be doing. As mentioned in the previous article, each welder is required to make a test piece each month. This is done to guard against the possibility of any of the welders becoming careless and turning out inferior work.

In the shop the welder must necessarily work under many different conditions, at one time he may be working on small work, at another time he may be working on large work that will require a greater amount of current and larger metallic electrodes, and the same man may at times be placed as a welder on the erection of large buildings. In any case it is

A Comfortable Position Improves the Quality of Welds on Small Work

†Head of Trades Training, Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

important that he have a good working knowledge of the expansion and contraction of metals under various degrees of heat. He must be able to work while lying prone, sitting, or standing erect to do overhead welding. He also must be able to weld the different grades of steel and alloys.

Training under all these different conditions cannot be given in the school, therefore, it is necessary that part of it be done in the shop under actual working conditions. All the

Student Welding on Structural Steel

training must be done by men who are expert welders and instructors.

It can be readily seen that the only practical place for a welding school is in the shop where welding is being done. The development of welding has been going on very rapidly the last few years, and in order that industry may take full advantage of this development, we must keep ahead or at least abreast of it in training men to do the work. In this way only, can the engineers go ahead with the design of welded apparatus and the manufacturers obtain the reduced factory costs that are possible in welding.

Welding in itself is a trade, and cannot be learned from lectures or the study of a book alone. It is an art that must be learned by practical experience and plenty of it, and for this reason it is difficult for the independent welding school to do a good job of training.

The Welder is Often Called on to Do Work in This Position When Working on Pipe Lines

However, if we are to have independent schools, they should be placed under the jurisdiction of the Department of Public Instruction or the State Board of Education, and should be required to comply with rules and regulations as specified by that body.

1. Each school should be equipped with enough modern electric arc welding machines, of both the single and multiple operator type, so that each student would be able to get at least eight hours of practical experience to one hour of lecture. The course should also include instruction in oxy-acetylene cutting and welding.

2. Testing equipment should be provided for testing the specimens as they are made, so that the student may actually see the results of his work and the instructor be able to point out things to be avoided.

3. The instructors in these schools should be required to pass an examination and demonstrate their ability. They should be, not only expert welders, but also skilled mechanics or fitters.

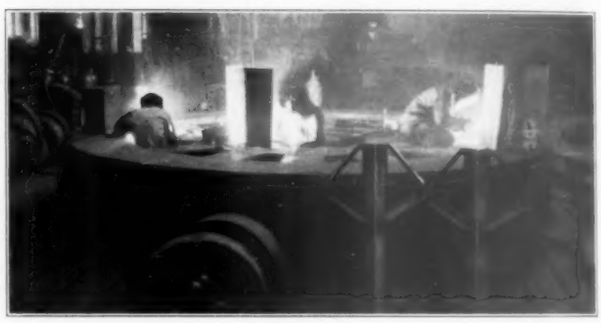
4. The entire course should cover a period of at least two hundred and fifty hours.

5. Care should be taken in selecting men for training in the welding school. As yet no method has been devised other than the destruction of the weld by which the work of the welders in the shop may be inspected, except for outside appearance. Therefore, we must depend upon the honesty and the conscientiousness of the men doing the work.

6. The school should make a special effort in building up pride of workmanship of the student that would prevent them from turning out anything but the highest grade work.

7. At the completion of the course the student should be given a test consisting of a number of welded specimens. Those who pass the test should be given a certificate stating the kind of work done and the degree of skill attained.

These men could then be hired by manufacturing concerns,



Welding on a Fabricated Machinery Part

and perhaps, with very little additional training be placed as regular welders, but unless these conditions are fulfilled, students in such schools will not receive satisfactory training and will be unable to find permanent employment as welders.

Even so, it will always be necessary for the manufacturing concerns to do a large part of the training, since confidence is gained and skill acquired by doing actual work, and much of the work is of a special nature that cannot be anticipated by the independent school.

The illustrations which accompany this article show the various conditions under which a welder is required to work. It also shows the different positions that he is required to maintain while working. This kind of experience, of course, cannot be given in the school.

Los Angeles Section of A.W.S. Discusses New Boiler Code

The regular meeting of the Los Angeles section of the American Welding Society was held in the evening of June 16th. An interesting discussion was entered into by several of the members and visiting guests on the subject of machining or sand blasting edges of plates to be flash welded. Mr. Page of the State Boiler Inspection Commission and his assistant, Mr. Evans, gave some interesting remarks regarding a tentative code for state or national qualification of welders, especially to men welding on pressure vessels. Turner Smith, a local member, prepared a summary of the new Boiler Code as applied to Unfired Pressure Vessels, and led a discussion in which the salient features of the new code were defined.

How to Weld Brass and Copper Pipe

Investigation Shows Bell-Type Joint to Be Stronger and the Short-Bell More Economical—Bronze Filler Material Provides a Stronger, More Homogeneous Joint

ON account of the fact that copper and brass do not rust, and therefore offer great resistance to corrosion, there is constantly increasing use of brass and copper piping and tubing for the construction of water lines in industrial buildings, public buildings, and residences, particularly in those localities where the water supply has a strong tendency to corrode iron and steel pipe. The fact that the use of the oxy-acetylene welding process for making these pipe installations has as many advantages in the case of copper and brass piping as in the case of steel pipe is well demonstrated in an article in the June issue of *Oxy-Acetylene Tips*, from which the following material is abstrated:

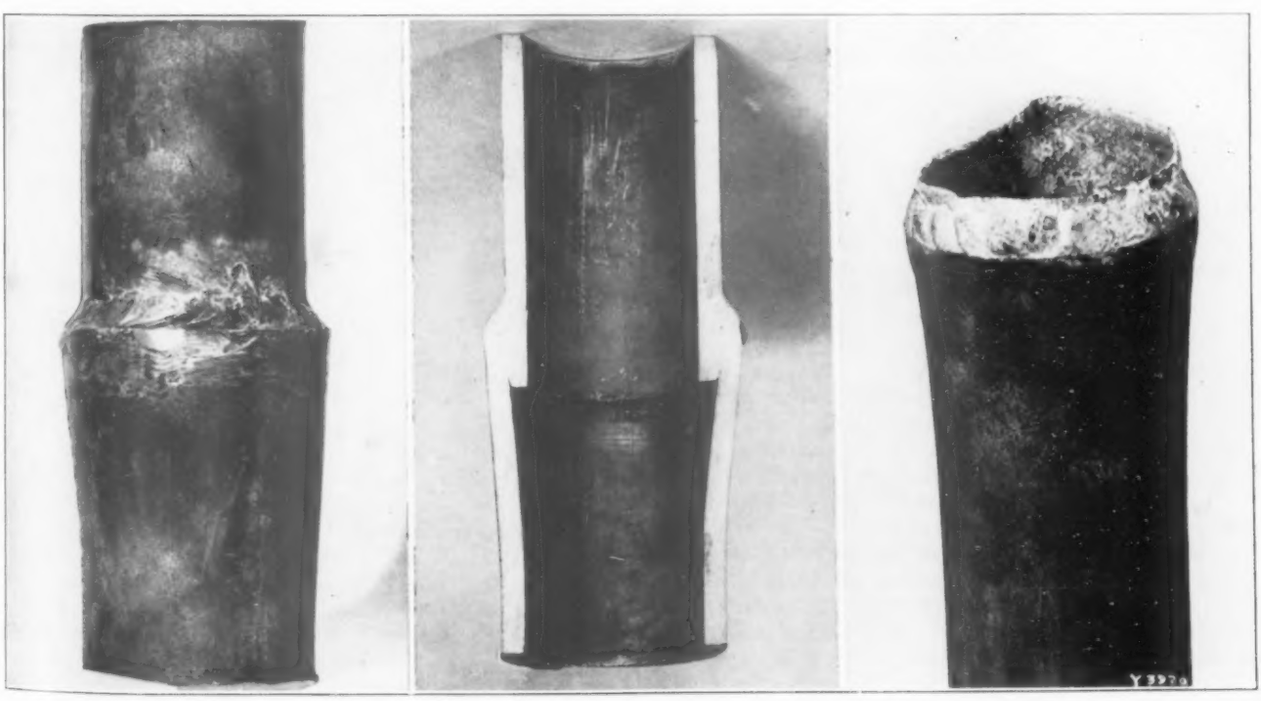
The big economic advantage of welding in this application is immediately apparent when a comparison is made with the use of threaded fittings. The wall thickness of a threaded piece of pipe must be heavier than a welded pipe, assuming the same pressure conditions, because the wall must be heavy enough to take a full depth thread and still leave sufficient thickness to carry the pressure. In other words, if the pipe has sufficient metal at the bottom of the threads, there is an excess of metal over the rest of the length, whereas with welded tubing, there is no reduction of cross-sectional area, and therefore thinner wall pipe may be used to carry the same pressure, and since material is money, the cost of tubing for welded water systems will be appreciably less.

Furthermore, the joint which is welded becomes an integral part of the pipe itself and is equally strong as the base metal. No dependence is placed on white lead or on the closeness of a mechanical fit to insure a tight joint. This is of particular value where lines are run in inaccessible places or set in concrete where repairs could be made only with extreme difficulty. Welded installations, therefore, mean a greatly reduced maintenance cost, which is the great bug-bear of mechanical joints.

An exhaustive investigation was recently made by the Union Carbide and Carbon Research Laboratories, Inc., to determine the most desirable type of design for joints in copper and brass tubing, the best welding procedure, the most suitable welding rod, the weldability of the joints in various positions, and the relative strength of the various joint designs. As a result of this investigation, there have been recommended standards of procedure for the bronze welding of copper, red brass, Alpha brass and Muntz metal tubing. In these tests, the copper welding rod used was Oxweld No. 19 cupro welding rod and the bronze rod was Oxweld No. 21 high strength bronze welding rod.

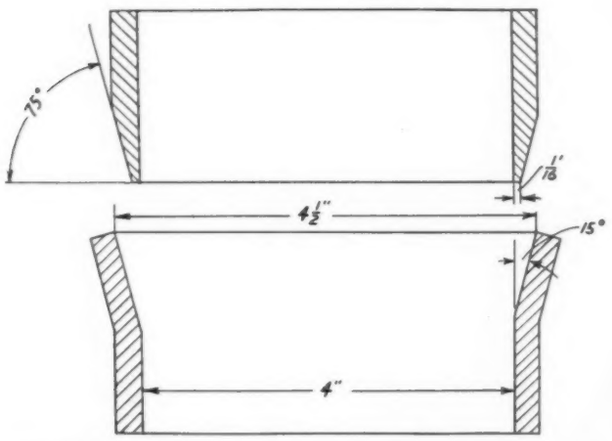
In the case of the tests with copper tubing, three types of joints were investigated. These were butt weld, long-bell and short-bell joints. The belled joints were formed by driving a dolly or tapered plug into the pipe until the desired shape had been obtained. This works all right in a laboratory, but it is recommended that a better method for obtaining a short-bell is to flare the end of the pipe on the horn of an anvil, using a wooden mallet. This can be done by hand. The tensile tests made indicated that the short-bell type of joint is just as strong as, if not stronger than, the long-bell type of joint, and since the short-bell type has the economical advantage of using up less material, the use of this type is recommended.

Full strength welds were obtained in ¾-inch copper pipe using either the copper or the bronze welding rod. The tensile strength of the pipe metal as annealed by the welding heat averaged 29,200 lb. per square inch. The bell type joint proved superior to the butt joint when the pipe was welded



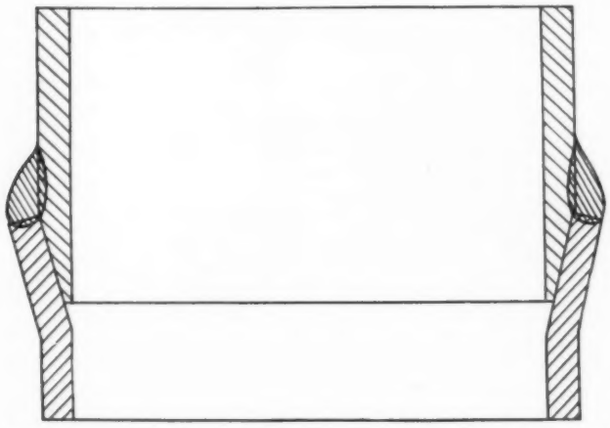
(Left) A Short-Bell Type of Bronze Welded Joint in Red Brass Pipe. Cut-away Section of This Joint is Shown in Center View. Result of Tensile Test is Shown on the Right

in a vertical position, and both types proved satisfactory for making a horizontal position weld. The bronze weld, however, was found to have a distinct advantage over the fusion weld, since the weld metal from the former solidified less rapidly, making the weld much easier to control to avoid porosity. In the case of 1½-inch copper water pipe, the bell type joint made with bronze welding rod proved to be decidedly stronger than joints made with copper rod, whether the joints were made in a vertical or horizontal position.



How Brass Pipe is Prepared for 75-Degree Bevel Short-Bell Joint

Tests were also made on all three types of joints on 1 inch and 2½ inch pipe of red brass, using the bronze welding rod. On the smaller size, the bell joints all broke in the base metal adjacent to the weld at an average strength of about 39,000 lbs. per square inch, which is the strength of red brass pipe when annealed by the welding heat. All of the butt joints broke at low strength either through the weld metal or along the scarf. The bell type of joint is therefore recommended as being superior for either vertical or horizontal position welds. Similar results were obtained when the same tests were made on the 2½ inch red brass tubing. A test was also made on the larger size pipe by using strips cut from the base metal as welding rod. This was unsatisfactory, as the weld metal proved difficult to control and developed porosity.



This Shows Completion of Recommended Design for Short-Bell Type Brass Pipe Joint

Satisfactory results were also obtained using the bronze welding rod on pipe made of Alpha brass. All of the bell-type joints welded in both horizontal and vertical positions broke in the pipe metal at the full strength of Alpha brass annealed by the welding heat. The butt joints, however, were not satisfactory. They did not show as high strength and there was great difficulty in preventing the weld metal from protruding into the inside of the pipe.

The welding of Muntz metal presented an entirely different situation from that presented by any of the other copper alloys previously mentioned, because the melting point of this alloy is as low as that of the bronze-welding rod. True fusion of the welding rod and the base metal is therefore obtained. The short bell joints made in 1 inch diameter Muntz metal pipe using the bronze welding rod showed a strength of about 36,000 lbs. per square inch, which is more than sufficient for the average service of water pipes. Some improvement in the appearance of the weld in Muntz metal could be made by using a flame with excess oxygen but the disadvantage was observed that there was an increase in the undercutting in the pipe when vertical welding was performed.

The general recommendation made as a result of these investigations is to use the short-bell type of joint and the bronze welding rod for the various types of copper and brass pipe and tubing which are now in general commercial use.

A Welded Brass Hot Water System Using Short Radius Turns

Short-radius turns designed especially for welding have been used extensively in making steel and wrought iron pipe installations. These short-radius turns are now available in brass and simplify both the design and the construction of welded brass piping systems. When these are used, the end of the straight length of pipe is flared in each case so as to fit over the end of the short-radius turn.

To meet the general demand for specifications covering the oxy-acetylene welding of steam and hot water brass piping in the industrial and building fields, the Linde Air Products Company has prepared a recommended specification, which may be added to or incorporated in any general specification for piping installations. These specifications cover such subjects as the selection of the welding rod, qualification of operators, the making of line joints, the making of welded fittings, and the testing and repairing of leaks.

Proven Production Welding Methods

A Study of Various Welding Departments Indicates Successful Results Are Based on a Few Fundamental Principles

THE variety of problems involved in the use of welding processes in fabrication makes it necessary to restrict the formulation of standard methods to a few general principles. One does not go far in his investigations, however, without finding that production managers of widely different types of articles have considerable opportunity to profit by acquainting themselves with the methods used in other shops. In this article are given the methods used in production welding in a few plants in the Los Angeles district, with illustrations which show some interesting design features.

Welding in various forms and processes is employed by the Dahlstrom Metallic Door Co., in their Pacific coast plant in Huntington Park, Calif. Figure 1 shows an electric welder at work on a steel door frame. Figure 2 pictures an oxy-acetylene operator at work welding a flush door. This job is also handled by electric arc and is frequently done by this process when the shop work permits. These doors are of 16 to 18 gauge cold rolled steel. The frames are of 12, 14 and 16 gauge furniture steel.

Figure 3 is a view of the spot welder at work on reinforcing sections of a metal door. This process is also used on the frames, skeletons of the doors, and channel reinforcement iron in the doors. This affords a nice finished job as compared to the metal doors of olden times when all doors and frames were of all riveted construction.

Figure 4 gives an idea of the way the finished doors appear, just before the final coat of paint is to be applied.

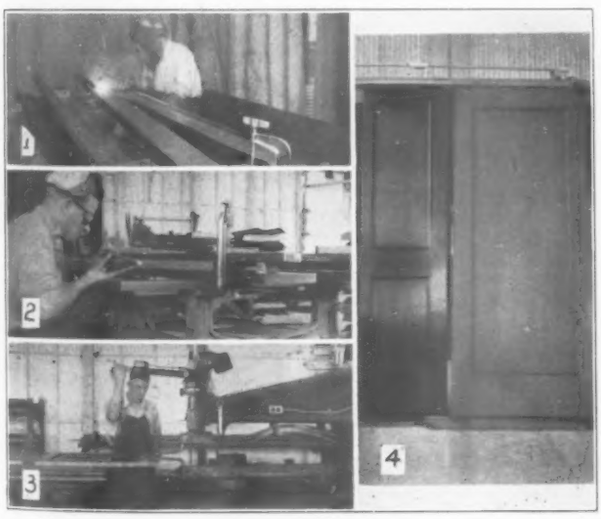


Figure 1. Arc Welding a Door Frame. Figure 2. The Gas Welder Makes a Neat Job on a Flush Door while (Figure 3) the Spot Welder Adds Reinforcement. Figure 4. Doors Before Paint is Applied.

It shows two doors complete except for the finishing paint job. These doors and frames are finished in all shades and colors, and to represent every kind of wood. When finished, the difference between the painted job and real wood is very difficult to detect.

Specially made steel tables of welded construction for the welding work on the company's products have been built, which provide means for executing the finest and most accurate kind of work. These tables are made to hold a door to provide a fit to five-thousandths of an inch. A view of one of these tables is seen in Figure 2.

A new labor-saving machine is being put on the market in the form of a recently patented device for applying plaster and concrete for many different uses. It applies the mixture to a surface very much as a paint sprayer applies paint. Fig. 5 shows the machine in operation, applying a coat of cement to the outside of a steel pipe. The machine is being manufactured by the Conley Plaster Machine Co., of Los Angeles, Calif.

The machine, when completed and assembled, is mounted on a trailer truck and can be easily and quickly conveyed

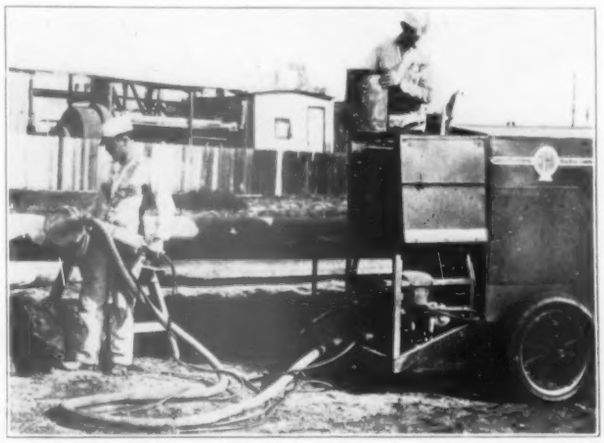


Figure 5. Welded Cementing Machine Applying a Protective Coating to a Steel Pipe Line

from one job to another by this means. It weighs about 2,200 pounds, and is four feet wide, four feet high, and seven feet long. The superstructure which incloses the motor and mixer is constructed of welded 1½x1½x⅛-inch angle iron, as pictured in Figure 6.

The trailer frame, shown in Figure 7, is sturdily built of 4-inch angle iron. A double 3-inch angle iron welded together forms the trailer tongue, to which is welded a steel coupling at the end. The double angle iron welded together to form the tongue, it is believed, adds extra strength over the use of an I-beam, as was originally designed. The hopper, shown in Figure 8, is of 16 gauge sheet iron and mounted on 1½x1½x⅛-inch angle iron.

By the use of welding the cost of production of this machine was greatly reduced over methods covered by the original designs and specifications, which called for a major portion of riveting and bolting. Added strength, together with a reduction in the weight of the machine, was also realized through the adoption of all-welded construction.

This machine appears destined particularly to affect the work of imbedding steel pipe in concrete for long-time preservation in cases where this is essential. A great saving in time and material in this one use of the machine will be effected. It is claimed by the manufacturers that a one-half-inch coat of concrete can be applied with the machine to a steel pipe without the use of any mechanical adhesive agency. Tests covering this operation have been made which prove it successful. This thin coat of concrete will preserve the pipe from corrosion or other deterioration. As a result of this development, it is prophesied that pipe line companies will adopt the use of much lighter pipe, due to this elimination of the action of corrosion, which should materially reduce

the cost of pipe lines of the type that require concrete imbedding.

A plant which maintains a high degree of efficiency in its welding work, not only from a standpoint of equipment and up-to-date methods and workmanship, but also which looks to the health, comfort, and welfare of its employes, is maintained by the Day and Night Water Heater Company, of Monrovia, Calif., where a large amount of welding is done. Different processes of welding are employed in different phases of the manufacture of the company's products.

For more than twenty years this company has devoted its efforts to the manufacture and improvement in design and

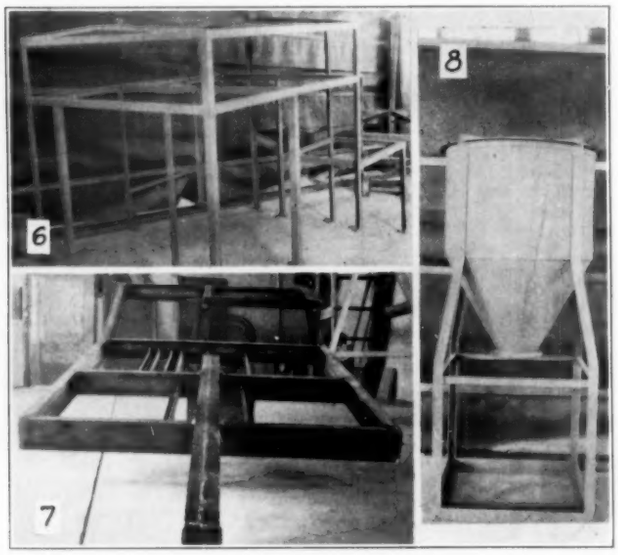


Figure 6. The Superstructure Welded from Angle Iron. Figure 7. This Trailer Frame is Stronger and Lighter Because It Is Welded. The 16-Ga. Sheet Iron Hopper and Mounting is Shown in Figure 8.

construction of water heaters, water coolers, and water softening equipment. The improvements and development which this company has made in their products have placed it in a position of prominence among the Pacific coast companies, and, to an increasing extent, has won the recognition in the markets of the entire western section of the United States as well.

The manufacturing plant is located on an eight-acre tract with a floor space of 60,000 square feet, and is one of the most modern plants of its kind in the entire West, in construction layout and facilities as well. The buildings were designed and constructed with the definite idea in mind of erecting a highly developed plant with all work allocated for efficient input of raw material and output of finished product, so that each department would function as a unit in perfect relation with every other department. The plant buildings are interconnected with concrete runways for quick and efficient transportation of material and products from one department to another. Specially designed steel platforms, bins, lift trucks and containers are provided for material so that these materials may be moved with a maximum of speed.

A two-ton all-electric traveling crane is used for the handling of heavy loads of raw materials, such as sheet steel, lumber for crating, zinc, and fittings, etc.

Figure 9 is a general view of a corner of the welding room in which can be seen several welders engaged in the different welding operations in the construction of water heaters. An unique and practical feature in the welding department is the color scheme of the painting of the walls and ceiling. From experimental tests and scientific study, it was concluded that orange color more effectively eliminates the glare and reflection of the electric arc, and as a result of this investigation, the company painted the interior of its welding department a bright orange color, with satisfactory and pleasing results as is vouched for by the workmen in that department.

One large generator room holds four 400-amp. electric welding sets, which furnish all the power for electric welding. A convenient and practical system for transmitting the electric current to the arc machines is in use here, which is arranged by copper bus bars being run the entire length of the welding department with leads dropped down every fifteen feet, which supply leads for each operator's electrode.

Specially made jigs and turning devices are used for the welding of all tank heads, bottoms, and heating flues, etc. Figure 10 shows one of these turning devices on which a tank is placed and which holds it at the proper angle. Revolving rollers operated by an electric motor through a chain shaft and belt drive combination turn the tank at an even slow speed, enabling the welder to make a uniform weld. In this operation a semi-automatic welder is used, being a flexible hollow shaft through which the welding rod is automatically fed. It is held by the operator at one set position and completes the welding operation as the tank revolves. A good view of this flexible electrode feeder is seen in Figure 11. This is one of the improved methods which the company has developed, and has resulted in the elimination of the difficulties formerly encountered in securing uniform welds in joining the concave top to their tanks. Production has also been materially speeded since the installation of the new turning device and semi-automatic welder. Figure 11 also shows another illustration of the semi-automatic welder in action. This photo shows a tank placed on a similar turning device. However, in this case the turning is done by hand and not by machine. The operation shown here is the welding of the bottom of the tank, an operation not so difficult as the concave heads, and for that reason the automatic turning is not necessary.

An automatic seam welding machine, which does the weld-

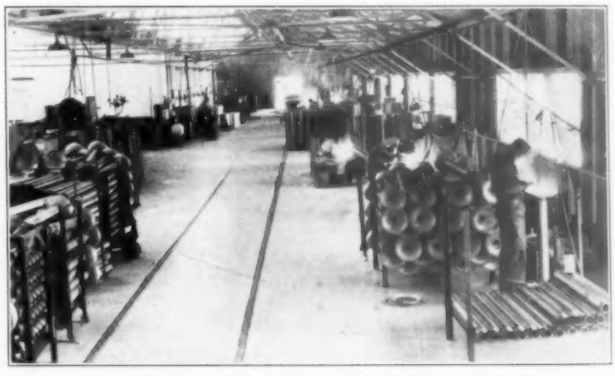


Figure 9. This Well Arranged Welding Department is Conducive to High Grade Workmanship.

ing of the longitudinal seams on the heater tanks with a production of from 20 to 40 tanks per hour, is one of the machines being used. A view of this automatic welder in operation is shown in Figure 12, with the operator watching the machine for any irregularity in its work.

Specially designed hydraulic presses are used in the manufacture and setting of the heads and bottoms and small parts for all of the tanks. These presses range up to 200 tons capacity.

The "hot-dip" process is used in the galvanizing plant, which is one of the most up-to-date of its kind on the Pacific coast. The plant is equipped with two overhead electric cranes for handling boilers to and from the pickling vats and galvanizing kettle. Automatic heat controls are used to maintain temperature of both the pickling acids and galvanizing metals, which eliminates the danger of error in coating the tanks.

Figure 10. Special Revolving Jig Assures Uniform Welds. Automatic Electrode Feeder is Shown in Figure 11

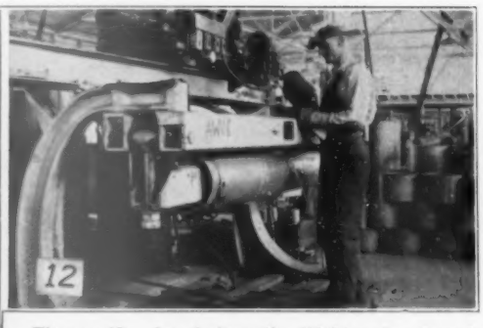


Figure 12. An Automatic Welder for Longitudinal Seams Speeds Up Production

A feature in the construction of the heating element of this company's water heater is a welded spiral fin which surrounds the heater flue its entire length. The water is thus heated quickly as it travels the long spiral pathway from bottom to top of the boiler around the three-inch center flue through which the hot gases of combustion travel. Most of the heaters are equipped with automatic self-acting safety burners. The working part of this safety feature is constantly in motion under operating conditions, the construction of which is of stainless steel and will not corode. This makes this part dependable and free from danger of sticking. The operation of this device is based upon the unchanging characteristic of metals which expand when heated.

The company has installed one of its own mechanical refrigeration units in its plant for the comfort and welfare of its employes. This unit provides cool water at all times for workmen at numerous bubbling fountains located at the various work centers of the plant. W. J. Bailey, founder of the company in 1909, is still president and general manager of the plant and organization.

Welded Shells Prove Cheaper Than Pipe

By Louis Stieglitz†

ONE of the most commonly accepted advantages in the use of the electric arc in pipe construction is the ability to fabricate in long lengths, thus limiting the number of field joints.

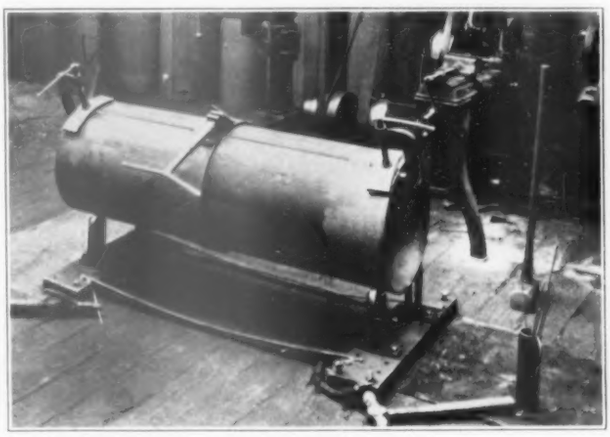
An entirely different aspect to the above has recently presented itself in connection with the subway construction work now in progress in New York City. In other words, welding has shown its advantages both on the "long or short" of it.

Route 103, sections 1 & 2 is being constructed by the Corson Construction Corp., through Essex street, on the lower East Side, eventually to connect up with a new tunnel under construction at Rutgers street. At Essex and Delancey streets it was found necessary to carry the new subway underneath the existing B. M. T. structure and to provide permanent underpinning for the latter.

Subway construction in New York is exceptionally difficult, and presents many new and intricate problems. When the final chapter is written, it will be found that welding has played a very important part in the solution of some of them.

Driving pipe piles for this job was manifestly impossible, due to the low head room. It was therefore finally decided to resort to jacking short sections of pipe, by the hydraulic method, and filling them with concrete, to remain as permanent piles.

The specification called for 4000 to 5000 lengths of 16-in. O. D. pipe ⅜-in. wall and 4 feet long. These were to be used in conjunction with a jacking or driving sleeve, connecting up the sections as they were jacked into the ground, by means of this sleeve.



The Welding Jig with Cylinder Shell Tacked and Ready to Weld

To have used standard steel pipe 16-in. O. D. ⅜-in. wall would have involved considerable labor and expense. Standard steel pipe, as we know comes in random lengths of 18 to 22 ft. To make this pipe usable on the job would have involved marking off, re-handling, laying out, and either machine or oxy-acetylene cutting it into the required lengths, with a considerable wastage of the left over pieces. It was

†*Manufacturers Welding Company, Inc., Brooklyn, N. Y.*

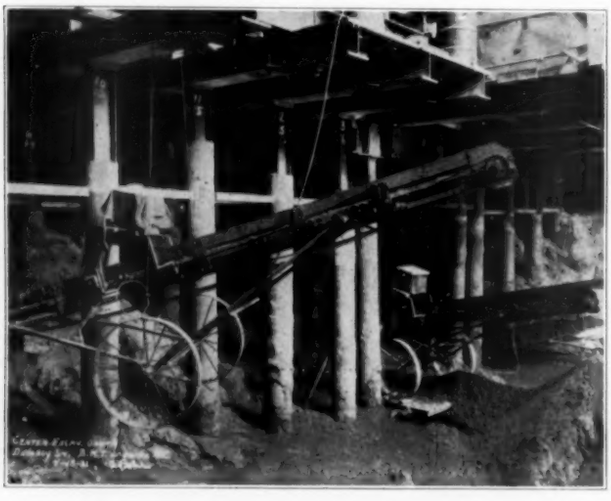
A Few of the Completed Shells

Bringing Shell to Circular Shape on Jig

therefore decided to use electrically welded pipe in 4-foot sections.

Sheets of ordinary ⅜-in. tank steel were obtained. These were passed through a set of bending rolls to form a circle 16 inch diameter by 4 feet long. From the roller, they were passed along to a tacking jig, where the rolled cylinders were drawn together to form a butt joint, and tacked along the seam. Following this, they were passed along to the electric welder, who welded the longitudinal seam. It was found after welding that due to the high current used (350 to 400 amperes), there was a tendency for the cylinders to contract and become oval, or egg shaped. Various methods were tried to eliminate this feature without success. Finally a jig was devised, which solved the problem successfully.

This consisted of a heavy tapered steel casting, absolutely true in diameter, Heavy lugs of 2½ x 2-in. material, were welded to its face, to act as expansion spacers. This was then machined down to the exact inside diameter of the pipe. A



The Welded Underpinning Casings on the Job

hook was welded to the center, and the entire thing suspended by block and fall from the ceiling.

After the welder had completed welding, the cylinder was passed along to the "straightener". Placing the jig on the open end, immediately disclosed the amount of variation from the true diameter. By means of sledging, and pressing in a pressing jig, the cylinder was then brought to true diameter. the process was then reversed on the other end.

A machined sleeve was the final test as to squareness, roundness and interchangeability of each end. It is noteworthy that in almost 25,000 lineal feet of welding required for this job, there was not a single failure of the weld during any operation.

Based on the above method, in comparison with the use of standard pipe, there was a saving to the customer of almost $10,000 which is certainly a considerable item, in these keenly competitive days.

Welding Used in Installation of Gas Booster Plant

The accompanying photograph is of a new gas booster station recently installed in the Venice oil field of southern California. The plant belongs to the Industrial Fuel Company of Anaheim, Calif., and connects with a 10-inch line from the Venice field, supplying the Southern California Gas Company with a portion of the gas furnished by this company for consumption by the city of Los Angeles.

In the erection of one of these plants, there is a great deal of welding, which is principally done by the oxy-acet-

The Oxy-Acetylene Process Plays a Large Part in the Installation of Oil Field Equipment

ylene process. Tying in the lines, making connections with the engines, together with general work of installing the power units, require considerable skill on the part of the welders.

This plant contains three units, which are the new Type-10, 200-horsepower Cooper-Bessemer make. Installation and welding work was handled by the Fluor Construction Co. of Los Angeles.

A New Kind of Magnetic Test

Much interest has been shown in inspection methods of the non-destructive variety in which the magnetic properties of the metals inspected have been put to use. Experimental work both in this country and abroad has resulted in several types of apparatus for inspection by the magnetic method. A new development along this line was the report discussed at a recent joint meeting of the American Welding Society and the American Society for Steel Treating at New York City. In this case the iron dust used has been developed in the form of a magnetic powder. The method has been used for the detection of longitudinal seams and other defects in seamless tubing and wire. It also has been used for the detection of quenching strain cracks in heat treated products and also forging cracks and grinding cracks. Fatigue cracks concealed beneath plated surfaces have also been detected.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

Flux Holder Saves Time and Gas

By R. C. Liebe

After wasting more welding fluxes than used, covering a period of two years in the welding department of my shop, an idea was hatched and put into effect that answers a two-fold purpose.

The average welder merely puts his cans of welding flux on the welding table or floor and when welding with his dark goggles over his eyes, feels about in the dim light for the flux while the torch wastes valuable gases, and even if he is successful in getting the filler rod into the can, time and gas are lost. Frequently the can is turned over, wasting much of the contents which cannot all be gathered up. Much of the time we have several cans of flux handy for welding different metals requiring separate flux, which makes the spills more frequent and the waste greater. Experienced welders know most of us are guilty of these wastes in gas, flux and time for lack of a method of preventing them. Note the remedy illustrated in Figure 1. This consists of a strap of iron ¼x2 inches and some 2 or 3 feet in length with one end bent to form a square some 6 inches down with a bracing strip of iron welded underneath as shown. On this 6-inch end which forms a square, a strap hinge is tack-welded, the free end of which is made fast to the wall with screws. This is so mounted that the end of strap will easily swing over the welding table at any point desired. Three or four empty cans (flux cans with covers) are riveted through the bottoms to the extension end of the iron strap as shown, providing containers for No. 1, cast iron flux, No. 2, brass and bronze flux, etc. As many as desired can be used. Cans are painted different colors to represent the different fluxes. In welding, the swinging arm is pulled within reach, bringing the flux over the work and the welder with a little practice soon learns to dip his rod without taking his eyes or torch off of the work by knowing its location. There are no turned over cans, waste of flux or gases in the use of this simple device, and any one can easily make it. When the job is finished, the flux holding arm is pushed back against the wall out of the way until more work is put in place, when it is again recalled for handy use.

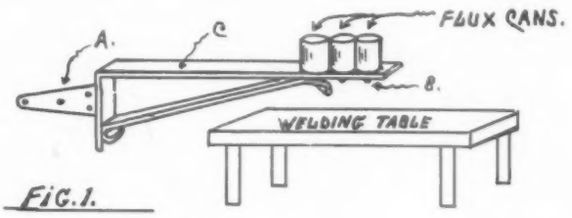


FIG. 1.

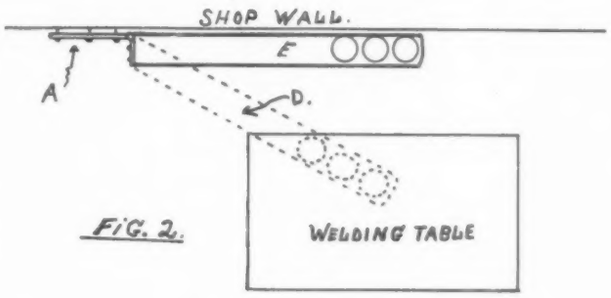


FIG. 2.

Referring to Figure 1, A, shows hinge; B, rivets to bottoms of cans; C, strap iron formed as shown with brace. Miniature table merely shows position for mounting device handy to work.

Figure 2 shows top view of device folded back against the wall at E, with can tops in view. At D, is shown adjustable or swinging feature described. We estimate a large saving of gases in a year's use, and our flux lasts twice as long as formerly.

The Welded Crank Case Finished the Race

During the preliminary trial runs for qualification in the recent Indianapolis races a 16-cylinder racing car "threw" a connecting rod, which caused considerable damage to the crank case of the machine. Since the time before the race did not permit ordering a new aluminum casting, some other means had to be found to place the machine in condition if it were to compete in the 500-mile grind. Knowing of the possibilities of oxy-acetylene welding the backers of the machine took it to the X-Welding Company, 620 Pierson street, Indianapolis, Ind., where M. H. Davis considered the possibilities of making a welded repair that would stand up under the severe strain of the long race. On examination Mr. Davis found that the biggest handicap that he had to overcome was the replacing of the broken section, all the parts of which were lost when the break occurred. After careful consideration, he decided that he could make a successful repair and was accordingly given the job.

To get the outline of the missing section, a piece of fairly stiff cardboard was placed on the inside of the case directly over the break. With a pencil the edges of the break were traced onto the cardboard, which was then trimmed along the pencil lines. A piece of 20-gauge steel was then used to secure the exact curvature of the case at the point of break. The next step was to transfer the outline of the missing part to the steel.

In building up the patch, Mr. Davis used square cast aluminum rods having the same expansion as the case itself. These were broken up into short sections and placed on the steel pattern in such a way as to secure the correct curvature. With a welding torch he then fused the rods together, building up with additional metal to secure necessary thickness for projecting faces. The steel plate was then removed and the

back of the piece welded together in the same fashion. The next step, after the piece had cooled, was to fit it and tack it in position for welding. When this was done the whole case and patch were carefully preheated with artificial gas to take care of the expansion and contraction due to welding. In all the welding a good grade of aluminum flux was used to take care of oxides formed and to assure a good sound joint.

The entire job was finished in six hours at a cost of approximately $40.00 and the saving to the owner of the car was $250.00. If it had not been for the experience of Mr. Davis in doing jobs of this kind and his ingenuity in building up the missing section, this particular car would not have been able to compete in the race, for a crank case of the type required was not available at any price.

Welders Make Their Hoists To Order

Job welding shops cannot handle a very satisfactory variety of work without being provided with some form of hoist for handling the heavy pieces. It is so economical to make up the required equipment, particularly when scrap material can be used, that many shops have built hoists, both portable and stationary, to suit their individual requirements. The illustrations in this article show a group of hoists made by shops in the California oil field district. There is such an abundance of pipe always available in the vicinity of petroleum industry operations, and pipe shapes are so satisfactory as structural members when assembled by welding, that it is quite natural to find the welders in this territory making generous use of pipe in their fabrication work. Since in practically all localities there is almost always at least a small

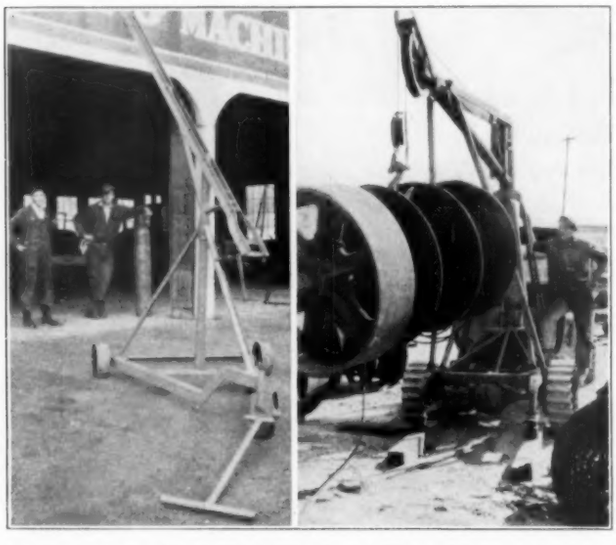


Figure 1. (Left) A Portable Welded Hoist Made of Pipe and Standard Shapes. Figure 2. (Right) Heavy Duty Hoist Which Incorporates Several Unique Features.

amount of scrap pipe available, welding shops in other sections may find here a useful suggestion.

Figure 1 shows a portable hoist built primarily for lifting steel jacket forms from concrete sewer pipe. This hoist, which was designed and built by E. E. Olds, of the Olds Machine & Welding Shop, King City, Calif., is constructed of three-inch angle iron for the frame, with six-inch channel iron for the base of the mast. Braces are of one- and three-inch pipe. The boom is of two-inch angle irons. The wheels, forming the portable feature of the hoist, are of welded construction throughout. The "tires" are ordinary oil well casing with spokes of two-inch strap iron cut, welded and fitted to form a solid disc wheel. 1¼-inch holes were bored for the axles, which are of ordinary shafting. Hubs are pieces of pipe of a size to fit the axle and welded on each side. Mr. Olds features general machine and welding work of all kinds. He has followed this line of work for fifteen years, six of which have been spent in his present shop in King City.

* * *

A unique type of welded hoist is in use by the Rieger Iron Works in Taft, Calif. Figure 2 shows this job. Mr. Rieger, who, in connection with his machine shop, handles new and second-hand oil field equipment of all kinds, found it necessary to construct some sort of portable hoist for lifting and moving heavy machinery and equipment from one part of his storage lot to another, loading and unloading, etc. An ancient taxicab was commissioned to furnish the power and portable feature of the hoist. On the end of the frame was built the hoist and winch, as shown in the picture.

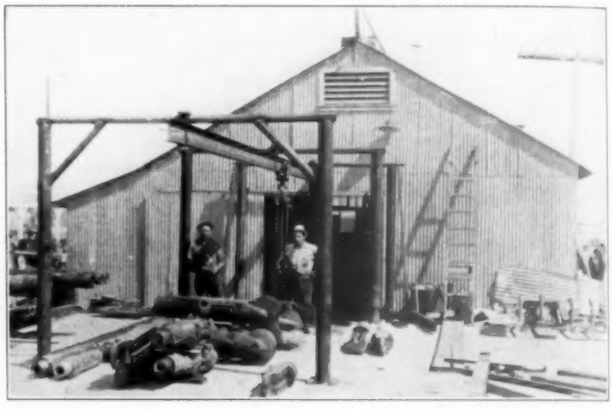


Figure 3. A Stationary Unloading Hoist for Handling Heavy Materials.

The hoist, which is of all-welded construction, is six-inch drill pipe for the mast, and the boom is four-inch pipe. Four-inch strip iron for strengtheners and three-inch pipe for braces finishes the description of the major portion of the material used. There are no bolts or rivets used in the construction. The hoist has a capacity of three tons. Lifting is, of course, done by a winch operated from the motor of the truck. On account of the sand in which this portable hoist has to operate, rubber tires as used on ordinary trucks are very impractical by reason of the danger of stalling from lack of proper traction. Thus the idea of removing the tires from the wheels and welding thereon pieces of two-inch pipe in cluster form was tried out and adopted. This also eliminated the danger of flat tires often caused by excessive loads being handled, and an extra saving is also realized in the elimination of the necessity of buying new tires. Furthermore, the "type" of tires developed in this way are much more effective in sand by reason of their caterpillar-like construction. Here welding was also put into practical use. One of Mr. Rieger's welders, D. Harrington, is seen in the picture, which also shows the hoist easily handling an oil well sand line weighing in the neighborhood of two tons.

* * *

Figure 3 is a back-door view of the branch shop of the Oil Well Core Drill Company at Taft, Calif. This company has just recently completed the construction of the all-welded crane extending out from the rear of the shop, which is used for handling heavy oil tools, equipment, etc., in all manner of repair work, welding, etc. The main supports of the crane are six-inch pipe to which are welded the cross members of three-inch drill pipe. Braces are also three-inch pipe and welded. The track of the crane is made up of two pieces of I-beams, which were welded together. This affords a convenient means of loading and unloading heavy equipment and machinery and conveying it to and from the shop. Exten-

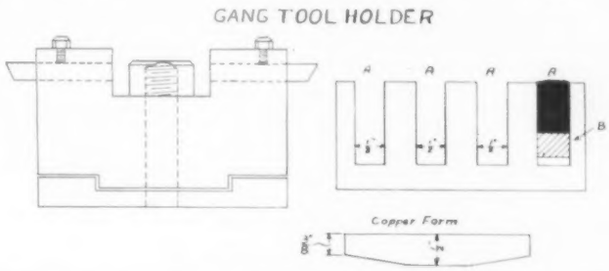
sions to the crane can be added at any time in the future. Note a number of large size bits in the foreground of the picture. These bits are the Guiberson make, which is widely known throughout the oil fields of California. The largest ones shown here weigh over a ton each. This company features general welding of all kinds in addition to their specialty of servicing drilling bits and core barrels. A. W. Young, manager of the branch shop, is shown at the left in the picture.

Welded Gang Tool Holder Speeds Up Production

By Jesse Alley

Where a series of cutting tools are required on a given job considerable time is spent in changing them which adds to production costs. In the accompanying sketch is shown a gang tool holder that can be easily made by the welding shop which I have found eliminates a great deal of the time spent in changing tools.

A piece of bar steel of suitable size is machined as shown on the left and then four slots ½x1⅜ inches are milled as shown in the side view on the right. A copper form is then prepared, as shown, with the ends tapered and ½ inch wide by ½ inch deep. This is placed in the slot and weld metal deposited flush with the top of the holder. After the deposited metal has cooled the copper form can be driven out, since metal deposited with the arc will not fuse with the copper as would be the case if the weld were made with the oxy-acetylene torch. After each slot is filled with weld metal the top and sides are machined or ground flush and a tool holder is provided at very small expense, but which will save a great deal of time in getting work turned out of the machine shop.



Sketch Showing Details of Tool Holder. The Slots "A" Are Milled Out and Weld Metal Deposited on Top of Copper Form "B."

Building a Job Welding Business

By W. Irving Brockson

V—Telephone Directory Advertising

THE telephone, the indispensable instrument in every business house, opens the door of every job welding shop to a fertile field of possible business.

The telephone in your shop entitles you to a free listing in the alphabetical section of the local telephone directory, one in the classified section and for very small expense to other classified listings.

The Most Used Business Publication

In large cities and small ones as well, the classified section of the telephone book is undoubtedly used more than any other business publication. It is a reference book which furnishes to any one interested a complete list of *all* the worthwhile business houses in the town. Its very completeness gives it one of its greatest values.

People from Maine to California and from Florida to Oregon have formed the habit of using the classified telephone book as a source of information about every kind of business under the shining sun.

Emergency Calls Directed to You

A given firm may have gone along for years without using welding, and suddenly develop a need for job welding shop service. Despite all the good work you may have done in the way of signs, direct mail and other forms of advertising, you may not have "registered" in the minds of the men who are now in a hurry to get some welding done—and quite likely no other shop has either.

What happens? The first thing this organization thinks of, ninety-nine cases in a hundred, is the classified telephone directory. The man interested in getting the job done, turns to the heading, "Welding" or "Cutting," etc., looks up the firms listed there and gets in touch with one or more of them. If your name is not there you are "S. O. L."—simply out of luck.

Serves When Memory Fails

Then, take another case. Perhaps you have written a certain superintendent a letter or you have called on him and given him a pretty good idea of what you can do. He did not have any work at the time but promised to give you a chance in the future.

"Smasho,"—A machine breaks down at ten o'clock this morning and a certain part must be welded before the machine can be operated again. The superintendent remembers your face or your letter but, for the life of him, he can't think of your name or the name of your shop. He says, "I'd know the name if I saw it, but I can't recall it now."

What does he do? Why, he looks in the classified telephone book, of course. And if your name is under the proper heading the chances are that seeing your name in print will recall everything clearly to his mind and he "gives you a buzz."

Free Listings

Although the custom of charges varies from one city to another, it is common practice to award one free listing in small type in the classified section to every firm that has a telephone. (Naturally the listing in the Alphabetical section costs nothing.) When the business is first established it is well to get in touch with the commercial office of your local telephone company and find out just what their policies are with regard to their classified directory and see that your shop name is spelled correctly and that it is listed as you desire both in the alphabetical and the classified divisions.

Extra Listings

Some directories have all the following sections which would interest the job welder:

Welding
Acetylene welding
Gas welding
Electric welding
Cutting

It is a good policy to have the shop name printed under all these or similar ones if they are available. Of course, all

listings after the first one cost a nominal fee per year but in most cases it is so small as to be worthy of little thought; it is very small indeed in proportion to its value. But here is where the worth lies. One prospect will look up the heading "Welding," whereas another will look up "Cutting" or "Acetylene Welding." If you are only under one heading, the fellow who does not use that particular one will pass you by.

Bold Type Listings

In order to have your name "stand out" among those listed under any classification, it is sound practice to order your name printed in large heavy type, known in printers' language as "bold face." Such a name is seen much quicker than one adjoining it in small type. Furthermore, such prominent type very distinctly tends to give the reader the impression that your firm is much larger and more important than the ones in smaller type. The telephone company will make a small extra charge for such type but it is well worth the cost.

Display Advertising in Telephone Directory

The most effective use which can be made of the classified telephone directory is through display advertising under the headings which logically apply to your business. Such an advertisement, occupying an inch or more in depth, stands out far more prominently and is seen more readily than the names in the printed list. Moreover, it gives you a chance to tell something about your business and what you can do for customers. When a man looks in the classified telephone directory for a welding shop he is obviously interested in some service which a shop can give. You should strive, by good display and proper wording of your advertisement, to have every person who looks up shops in the directory *call you* and not your competitor.

Someone has aptly said, "The more you tell, the more you sell." This has particular significance when applied to display ads in comparison with straight listings.

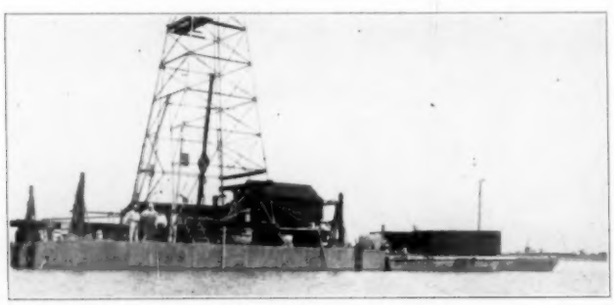
City Directories

In some towns there is a "City Directory" in addition to the classified telephone directory and listings and display space are available. If these books are in common use, are accepted by the people and are revised and reprinted at regular intervals by a reliable company or agency, they form a valuable advertising medium. However, they should be carefully investigated before being used, because they are not as uniformly good throughout the country as the telephone directory.

Welded Steel Barge Replaces Wooden Piling and Platform

By W. J. Krebs

Supplanting of wooden piling and platform formerly used for the support of oil rigs drilling in the shallow waters of Louisiana has been effected by the Jefferson Lake Oil Company by the use of a steel welded barge at its Lake Peigneur operations at the Jefferson Island Salt dome, Iberia parish, Louisiana, according to Arthur Barba, Sr., company president. The company anticipates savings upward to $100,000 by the use of the barge, which was erected on the shore of the lake.



The Welded Steel Barge Which Supplants Wooden Piling and Platform for Oil Drilling Rig.

During the past number of years the major oil companies have drilled for oil extensively in the shallow coastal waters and lakes of Louisiana, the work being carried on by the driving of piling to support the platform for the derricks. This method has been slow and costly.

The Jefferson Lake Oil Company has been drilling test wells at its sulphur deposit at Lake Peigneur. The field superintendent, Ed. Laguere, a graduate of Sorbonne University, Paris, France, an engineer of 30 years' experience in the Gulf and Mid-Continent fields, studied the problem. The answer was the erection of a welded steel barge measuring 40x60x 5½ feet, well strengthened by bulkheads, and provided with a slot down the middle to a point past the center to permit the vessel to slip away from the casing of the completed well. A 67-foot tubular derrick and the drilling machinery were mounted on the barge, affording a permanent set-up for the drilling program contemplated. The rig spudded in on May 12 and its operation declared most successful, it being stated that vibration is less than when the piling support is utilized. The barge is of quarter-inch steel and supports the present 50,000-lb. equipment.

Arc Welding Used to Advantage on These Plate Products

Two interesting features of plate fabrication are illustrated in the accompanying photographs. Figure 1 is a screw conveyor trough for sand and gravel. This is used for conveying sand out of ships. The construction allows the water to be drained out at the bottom while the sand is carried on, and the sand is washed in the process. This

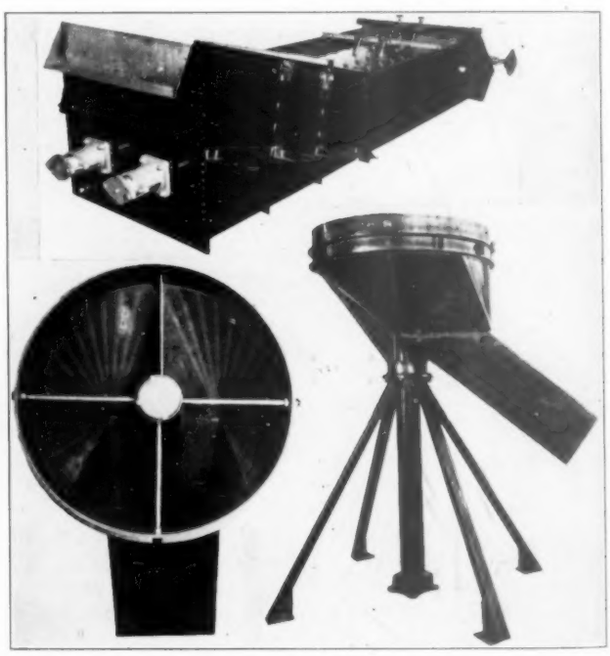


Figure 1 (Top) 200 Feet of Welding Are Used in This Screw Conveyor. Figure 2 (Right) Swivel Hopper Spout of Welded Construction. Top View is Shown in Figure 3 (Left).

piece of equipment is made of ¼-in. steel plate and one piece involves the use of approximately 200 ft. of welding. All of this is hand work.

The other two photographs show side and top views of a swivel hopper spout. This is an all arc-welded product, and is fabricated of ⅜-in. steel plate. The hopper revolves on a ball-bearing swivel joint. A rope attached to the drum at the top of the hopper is used to revolve the spout.

International Acetylene Asso. Will Meet November 11-13

The 1931 Annual Convention of the International Acetylene Association will be held in Chicago on November 11th, 12th and 13th. The program committee has already arranged for a number of technical papers of unusual significance under current conditions in finding the way to production and operating economy. Other papers will discuss constructive development in the redesign of products for more efficient performance or greater salability. Users of the oxy-acetylene process will find many suggestions for new uses and for improvement of their present procedure.

In announcing the dates for the forthcoming convention, the officers and directors of the association have laid particular emphasis on the benefits and advantages that come from a convention of this kind. Under present conditions, everyone is seeking ways and means of profitably extending his own business, and is naturally interested in methods of making intelligent economies in construction, production and maintenance. It is the purpose of the convention to furnish ideas for the extension of the use of the products of the members through intelligent study of markets or advance in design and efficiency.

Ryerson Purchases Reed-Smith Co.

In 1924 Joseph T. Ryerson & Son, Inc., purchased the interest of W. J. Reed and others in the Reed-Smith Company of Milwaukee, Wis. Now the Ryerson Company has purchased the remaining stock and the firm becomes the Reed-Smith Plant of Joseph T. Ryerson & Son of Wisconsin, Inc.

The Reed-Smith Company has grown steadily through its outstanding steel-service to the Milwaukee industrial area. This new move will add further strength to the Ryerson company's chain of warehouses located in ten principal steel consuming areas of the country. This acquisition represents one more step in the continued progress of the Ryerson Company which is one of the large independent steel-service organizations in the country.

Carbide Plant Makes Excellent Safety Record

A recently published bulletin of the National Lead Company calls attention to the perfect safety record made by Keokuk, Iowa, plant of the Midwest Carbide Corporation. At midnight on April 25th, one year's operation was completed without a lost-time accident. This represents a total of 153,000 man hours. This is an exceptionally good record, as many of the operations involved in handling large quantities of raw materials are hazardous; and the management attributes the entire success of the no-accident drive to the whole-hearted co-operation of the foremen as well as the employees of the plant. The safety organization at Keokuk consists of two separate committees. One of these is composed of foremen with W. J. Fulton, Superintendent, as chairman; and the other is a workmen's committee, with Houston Taylor, Chief Chemist, as chairman. With this type of safety organization, it has been found that many valuable suggestions are made through the workmen's committee to the foremen's committee, which are acted upon by the latter in the making of safety recommendations. It is interesting to note also from the same bulletin that the can shop of the National Lead Company at Keokuk has never had a lost-time accident since it started operation six years ago.

Pipe Welding Made Subject of Joint Meeting

"The Welding of Pipe for Water Lines" was made the subject of a joint meeting held on June 9th at the Engineering Societies' Building, New York City, by the New York Section of the American Water Works Association, the American Welding Society, and the American Society of Civil Engineers. "The Bronze Welding of Cast Iron Pipe" was discussed by T. W. Greene, Development Welding Engineer of the Linde Air Products Company. "Welding of Steel Pipe by the Electric Resistance Method" was the subject of a paper by J. S. Adelson, Chief Metallurgist of Steel and Tubes, Inc., Cleveland, Ohio. "The Welding of Large Diameter Pipe for Water Lines with the Electric Arc" was discussed by Mr. V. P. Marran, of the Walsh Holyoke Steam Boiler Works. All three of the papers were illustrated, and produced active discussion by members who were present.

X-Ray Service for Indianapolis District

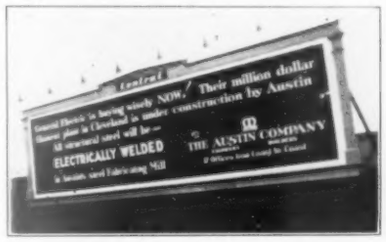
A local X-ray inspection service is now available to firms located in the Indianapolis district. J. D. Adams & Company of that city have recently installed complete equipment for X-ray inspection and have retained Mr. R. Notvest to act in a consulting capacity in connection with the

X-Ray Equipment in the J. D. Adams & Co. Laboratory.

X-ray laboratory. The equipment consists of a 140,000 volt Victor transformer and Coolidge transformer, a Snook rectification switch, driven by a Colonial synchronous motor. There is a Victor control cabinet and a General Electric 200,000 volt deep-therapy tube. The accompanying photograph is a view of this laboratory. J. D. Adams & Company are manufacturers of an all-welded line of road machinery. Mr. Notvest is a consulting-welding engineer and also sales agent for a complete line of electric and gas welding and cutting equipment.

Billboard Advertises Arc Welding for Building

The Austin Company of Cleveland, Ohio, is nationally known as a firm of engineers and builders, and in the welding industry they are well known for some of the pioneer work they have done in the application of welding to building construction. In addition to this ,they have done some very aggressive advertising of the welding process for building construction. One of their latest and most interesting advertising activities is the erection of two large, outdoor advertising signs in Cleveland, where they are doing some



This Illuminated Sign Tells the World About Structural Welding.

structural welding for a new building for the General Electric Company, as announced in the June issue of The Welding Engineer. It will be noticed in this sign that the emphasis is placed upon the fact that all structural steel in this new, million dollar plant will be electrically welded. One of these signs in Cleveland faces the right-of-way of a railroad and the other is adjacent to the 105th-Carnegie Building, which was erected some two years ago by the welding process.

New U. S. Steel Corp Magazine Features Welding Processes

The quarterly publication of the United States Steel Corporation, which was formerly published under the name of "U. S. Steel Quarterly", has been changed to the "Steelmaker", and the current issue, which is the first published under the new name, features the welding processes strongly in several articles. One article entitled, "New Science of Welding Makes Great Changes in Industry" by C. J. McGregor, Assistant Manager, Manufacturers Sales Department, American Steel & Wire Company, reviews briefly the importance of research work in the development of the oxy-acetylene and electric arc welding processes. It mentions the important part played by these processes in the operations of the subsidiary companies of the United States Steel Corporation and points out some of the recent developments which make these processes still more interesting to these companies on account of the markets which they are creating for various kinds of steel stock. It is also pointed out that the Corporation, through its subsidiaries, has contributed generously to the research work which has made such application as structural welding and pipe welding possible. At the same

time the American Steel & Wire Company has had its engineers at work in the development of welding wires for use in the application of both of these processes, and Mr. McGregor tells how the manufacture of this wire is kept under direct laboratory control. The use of welded rolled steel in modern machine design is described by H. G. Marsh of the General Sales Department of the Carnegie Steel Company, Pittsburgh, and the National Tube Company's new plant for making electric welded pipe is described by Max Rosenkranz, Engineer in the Vice President's department of the National Tube Company. One department of this company is equipped with the most modern devices for turning out pipe in a range of sizes from 14 to 96 inches in diameter.

Arc Welder Turns His Hand to Art

The accompanying photograph shows a 12-inch iron cup completely fabricated by the use of electric arc welding apparatus. The cup was fashioned by an arc welder in the Fort Wayne Works of the General Electric Company.

This Cup, Except for the Handles, is Made Entirely of Arc Deposited Metal.

The entire body and top of the cup is of metal which passed in the vapor state from the metallic electrode through the gap of the arc to the body of the work where the material was deposited in solid metallic form. The shell of the cup is approximately one-half as thick as the stem at its smallest part and the separate cap is also of the same shell-like construction. The handles are the only part of the cup that are not of the arc borne metal. They are solid metal rods which were first bent to shape and then welded to the body of the cup. The cup was presented to an official of the Fort Wayne works as a token of the maker's esteem.

Linde Campaign Wins Advertising Prize

Linde Air Products Company won the N. I. A. A. award given by *Class & Industrial Marketing* for the best and most complete advertising program exhibited at the National Industrial Advertisers' Association Conference, held at New York last month. The details of this prize winning campaign are given in a feature article in the July issue of *Class & Industrial Marketing*, written by T. C. Fetherston, Manager of the Technical Publicity Department of the Linde Air Products Company, under the title "A Large Part of the Advertising Job is Coordination." The award was made on the basis of a series of seven panels exhibited at the Conference. These panels showed the various features of the campaign, including trade paper advertisements, promotion booklets, instruction books, articles in *Oxy-Acetylene Tips*, motion pictures, illustrated letters, envelope enclosures, educational articles prepared for technical and trade magazines, and direct mail help prepared to aid the dealers in selling the equipment. Mr. Fetherston's article shows the enormous amount of effort necessary to obtain the complete acceptance of a process throughout an industry, and the great importance of arranging a program based upon complete coordination of sales and service facilities with advertising and sales promotional work.

Steel Sphere Tested to Destruction

Much interest has been shown in a series of tests conducted by the A. O. Smith Corporation of Milwaukee, Wisconsin, on a welded steel sphere of a type which they had proposed to furnish to the United States Navy for the transportation and storage of helium gas. This sphere was 7 feet 10 inches in diameter and made from heavy alloy steel plates, all welded. After being subjected to a series of tests which included hammering with powerful air hammers for 72 consecutive hours while under 2360 pounds per square inch pressure, it was finally made to fail by raising the pressure to 5700 pounds per square inch.

Pressed Steel Tank Co. Appoints P. T. Babcock Sales Manager

Effective July 1, 1931, Mr. P. T. Babcock, eastern representative of the Pressed Steel Tank Company, with offices in the Vanderbilt-Concourse Building, New York City, took over complete charge of company sales with headquarters at Milwaukee, Wis.

Mr. Babcock became associated with the company in 1919 a salesman in the Chicago territory, later being placed in charge of the New York office.

P. T. Babcock.

The New York office of the company will continue at the present address under the direction of Mr. Norman A. Evans.

The company manufactures steel shipping containers consisting of a complete line of steel cylinders for gases such as acetylene, liquified petroleum, sulphur dioxide, methyl chloride, etc., also barrels and drums including Hackney containers with removable head.

American Murex Corp. Formed

An announcement of considerable interest was made recently by the directors of Murex Ltd., of England. After the declaration of an interim dividend of 15 per

Twelve all-welded tanks, the largest of which are 50 feet in diameter by 30 feet high, will be constructed for the Patchogue Oil Terminal, Patchogue, Long Island, N. Y., by the Buffalo Tank Corporation, Buffalo, N. Y. The illustration shows a number of the welded tanks in various stages of construction. Vertical seams are welded on one side only, circumferential seams on both inside and outside. Detailed description of the work will appear in an early issue of The Welding Engineer.

cent, an account was given of the recent activities of the company, in which it was announced that negotiations have been begun for the formation of a new subsidiary company in the United States, with a view to extending the welding interests in America. As the result, a new company has been formed, under the name of American Murex Corporation, the participants in which are Murex Ltd., and the Metal and Thermit Corporation of America. This latter concern has an excellent welding organization, and will handle the products of the American Murex Corporation. Following the amalgamation, in January last, of Alloy Welding Processes Ltd., and the Premier Electric Welding Co. Ltd., under the name of Murex Welding Processes Ltd., satisfactory results have been shown in their manufacturing operations, which have been concentrated in one factory.

New Supply Firm in Buffalo

The Bannar Welding Supply Company, 156 Main Street, Buffalo, New York, was recently organized by Mr. R. W. Bannar and Mr. C. G. Beebe. Mr. Bannar, for some years past, has been in charge of sales of welding equipment and supplies for Root, Neal & Company of Buffalo, N. Y. His experience in the welding field dates back to the welding of a gas distribution line in the state of Kansas in 1915. It will be the policy of the new company to handle everything needed for both gas and electric welding, including apparatus, welding machines, complete lines of welding wire, including special welding electrodes, and a complete line of solders, fluxes and other supplies. The new company has mailed out an attractively printed advertising blotter containing the announcement of the new service and a list of the products for which it will act as distributors in the Buffalo district.

Portable Arc Welding Unit Completely Rebuilt

The Mon-Arc Welder & Electric Company, located at 1314 E. 107th Street, Cleveland, Ohio, are marketing a portable gasoline engine driven electric arc welding unit which represents a very thorough job of rebuilding. The power unit is a used automobile engine. This is equipped with a specially constructed governor, so that the engine will run at a uniform speed of 1200 R. P. M. at no load or full load. An idling throttle is also provided. A generator frame of standard high grade make is used and redesigned and rewound completely. New Commutators and new brushes and brush holders are installed of ample capacity to carry the high welding current without overheating it. A standard 110 volt, ½ k. w. generator is used for an excitor. A special reactor is supplied with ample carrying capacity. There is also a special switchboard fully equipped. This is all mounted on a steel chassis provided with automobile wheels and pneumatic tires. The front axle has steering spindles and tie rod arranged so that it may be towed very easily behind a pleasure car or truck. It is stated that the excitor supplies sufficient capacity to operate electric drills, electric grinders, etc. It is claimed that the welder will weld at 300 amperes continuously or can be reduced to weld light sheet metal. The radiator supplied has ample cooling surface so that it will not boil under hard usage. Mr. E. Levison, president and chief engineer of the company, is a member of the A. I. E. E., and has been specializing on the design and production of special motors and generators for the past thirty-five years.

St. Louis Welding Society Features Pipe Application

The June meeting of the St. Louis Welding Society, which was held at the plant of the Midwest Piping & Supply Company, St. Louis, Friday, June 26th, was attended by about one hundred and sixty men, in spite of the fact that the thermometer was registering in the neighborhood of 100 degrees. Mr. F. C. Fantz, Vice-President of the Midwest Piping & Supply Company, conducted the group through his plant and answered questions pertaining to the different phases of welding methods employed at the plant in the fabrication of high-pressure piping and equipment. The program included the testing of 24-inch headers of 3/8-inch wall thickness. These were tested to destruction at 1,750 pounds pressure, and the behavior of the parent and weld metal was studied and observed. Opportunity was also offered to examine a 135-ton hydraulic press, designed and built by the Midwest Piping & Supply Company for their own use.

Frame for New Telescope Is Welded

What is considered to be the first arc welded steel frame or tube for an astronomical telescope is to be installed at America. This 69-inch mirror was produced by U. S. Bureau of Standards. Perkins Observatory, Ohio Wesleyan University. This telescope provides for the first large telescope mirror made in The tube is about 25 feet long and 6 feet in diameter. Welded steel construction was used to save weight, reduce cost and give a structure with a minimum of deflection. The telescope was manufactured by the Warner and Swasey Company, utilizing the Stable Arc process of The Lincoln Electric Company.

Welded Telescope Frame Which Provides Greater Rigidity.

E. L. Mills Elected Vice-Pres. of Bastian-Blessing

Ellsworth L. Mills, formerly sales manager for The Bastian-Blessing Company, Chicago, makers of the "Rego" and "Red Star" line of gas welding equipment has been elected vice-president of the company. Mr. Mills continues in charge of sales.

Ellsworth L. Mills.

This appointment is not a surprise to those who have followed Mr. Mills' career. He has for years been prominent in the industry, and has sponsored several movements to better conditions within the entire industry. As president of the Gas Products Assn., he has done considerable to promote better marketing methods among all competitive companies. Mr. Mills' experience in welding dates back to days, when as a young engineer, graduate of Cooper Union Institute, he foresaw the possibilities in the development of the welding field, and he has devoted himself to this since that time.

"The fact that only twenty per cent of the possible uses of welding are now employed indicates that the industry is far from the saturation point. Our greatest work is to educate the user to the full possibilities of welding," says Mr. Mills. "We will use every supporting medium to accomplish this. We will continue research and we will augment our engineering facilities to meet future needs. Our sales staff will continue to spread the gospel as in the past. Because of the fact that it answers a real need, and because it employs modernized merchandising methods, the welding and cutting industry is forging ahead at a tremendous rate."

New Series of Mailing Pieces Describe Hobart Welders

Hobart Bros., Troy, Ohio, manufacturers of electric arc welders and supplies have recently produced an interesting series of mailing pieces which describe in

detail the construction and uses of their equipment. The series in its entirety takes up various points of construction and describes them thoroughly. In addition many applications of welding in various kinds of metal fabrication and maintenance are pointed out.

Lincoln Bulletins Describe Structural Shape Welding

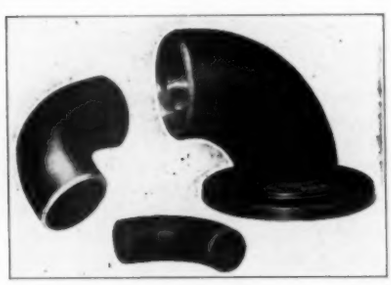
The Lincoln Electric Co., Cleveland, Ohio, have recently issued two bulletins which describe the application of welding to various structural shapes. The first, "Arc Welded Mill Buildings" illustrates various lattice frames and works out the problem of design and strength needed for various conditions of load. The second, "Elementary Classifications of Bases" takes up briefly the elements of design in constructing bases of structural units by means of welding.

Bulletin Describes New "Electroweld" Welders

The Electric Arc Cutting and Welding Company, Newark, N. J., has just issued a descriptive bulletin covering its new "Electroweld" combination arc and spot welders. Two of these machines are portable, while the two companion units are designed for permanent erection.

Welding Elbows for Wrought Iron Piping

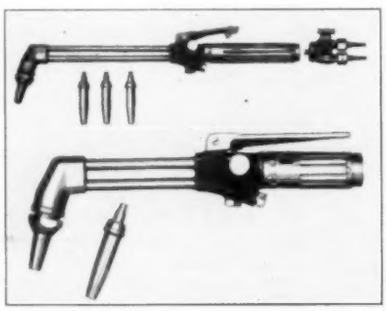
A line of welding elbows made of wrought iron for use with wrought iron piping has recently been announced by Locomotive Terminal Improvement Company, Chicago, Ill. These wrought iron elbows are not made from special plate but from the standard Byers wrought iron pipe skelp, 4-in. elbows being made of 4-in. pipe skelp, and 6-in. elbows of 6-in. pipe skelp. In making them, two pieces of homogeneous plate are cut to proper size and forged to the exact radius and dimensions. They are then fused together with a reinforcing rib along both the outer and inner radius of curvature. The finished product has the same radius and center-to-face measurement as standard radius fittings. They are forged with a tangent on each end so that they are interchangeable with standard fittings in the revision of existing piping. They have the standard wall thickness to conform to the standard weight of pipe of equivalent diameters. Unless otherwise specified, these elbows are furnished with both ends beveled 45 degrees for welding. The product has been given the trade name of Weldell. They are made also of light gauge material for use with standard light weight spiral welded or spiral riveted pipe. They are also supplied with forged steel or cast steel flanges welded on either one end or both ends. These flanges are forged in both standard weight and light weight to conform to the pipe on which they are used. In addition to wrought iron, these elbows are available in Toncan iron, Armco iron, copper bearing steel, and wrought steel.



Short Radius Weldells.

Introduce New Prest-O-Weld Cutting Apparatus

The Linde Air Products Company, 30 East 42nd Street, New York, N. Y. has recently added a cutting blowpipe and cutting attachment to its new line of Prest-O-Weld medium-pressure apparatus of the detachable valve body design. The new cutting apparatus includes the Prest-O-Weld Type C-105 cutting blowpipe and the Prest-O-Weld Type CW-105 cutting attachment.



Prest-O-Weld C-105 Cutting Blowpipe and CW-105 Cutting Attachment.

These two types of cutting apparatus, together with the Types W-105 and W-106 welding blowpipes recently announced, can all be used interchangeably with the same detachable valve body. By means of the detachable valve body, the operator can change easily and quickly from a full size welding blowpipe to a smaller welding blowpipe, to a full size cutting blowpipe, or to a cutting attachment without detaching the hose or hose connections and without the use of a wrench.

The locking device for connecting the detachable valve body to any one of these blowpipe handles consists of a locking bolt and wedge-shaped locking screw. The locking screw is operated by turning a ring and draws the detachable valve body and blowpipe handle together making a gas-tight joint. The ring can also be used for hanging up the blowpipe when not in use.

Pressure forgings are used in the construction of the blowpipe head, cutting valve body and lever. The cutting oxygen tube is made of Ambrac, a special hard brass, to afford the necessary stiffness. The cutting nozzles have conical seats so designed that they will not become nicked or damaged if the nozzles should be accidentally dropped.

The blowpipe is light and well-balanced, but at the same time it is of sturdy construction to withstand the hard usage to which cutting blowpipes may be subjected. It is furnished as standard with four cutting nozzles and a 75-deg. angle head. If required, a 90-deg. angle head can be furnished. Steel and wrought iron up to 12 in. in thickness may be easily cut with this blowpipe and metal of greater thickness can be cut by experienced operators.

The Prest-O-Weld Type CW-105 cutting attachment is of the single joint design and attaches directly to the valve body. It will readily cut metal up to 2 in. in thickness. Because of its small size, only 11 in. overall, it can be conveniently carried in the pocket of the operator when not in use. All the advantages of design and construction embodied in the full size Type-C-105 cutting blowpipe are incorporated in this cutting attachment. It is furnished with nozzles Nos. 1 and 2 of the same type as used on the Type C-105.

Manganese Electrode Utilizes Shielded Arc Process

An electrode which utilizes the "Shielded Arc" process to build up worn manganese steel castings has been developed by The Lincoln Electric Company, of Cleveland, Ohio. According to the manufacturers the new electrode known as "Manganweld," not only simplifies welding procedure but also produces a weld with the structure and qualities of wear-resisting cast manganese steel.

"Manganweld" electrodes are 11 to 15 percent manganese steel and the weld is "air toughening" which eliminates the necessity of quenching the bead. A heavy extruded coating provides a shielded arc, allowing the transfer of metal to take place under non-oxidizing conditions. This coating also decreases arc disturbance and boiling in the crater, and provides a layer of easily removable slag which further protects the weld from the harmful effects of the air.

It is stated that "Manganweld" causes the weld to remain in the Austenitic state even on slow cooling. Water quenching is thereby avoided.

Laboratory experiments show that "Manganweld" as reposited has a Rockwell C hardness of 5 to 10; and after cold working, attains a Rockwell C hardness of 45 to 50. "Manganweld" electrodes are used with reversed polarity. Suggested amperages are as follows:

Wire Size	Amperage
1/8 inch	50- 90
5/32 inch	90-130
3/16 inch	130-170
1/4 inch	170-225

In using "Manganweld" the work should be free of rust and defective material and precautions should be taken to keep the work cool, although the deposited metal does not need to be quenched. The metal should be deposited in pads ½ inch to 1 inch wide and not more than 3 inches in length. Long narrow beads should be avoided. After each pad is deposited it should be hammered to stretch the metal and thus compensate for the shrinkage which takes place in cooling. Before the next pad is deposited the work should be cleaned of all slag. The new

electrode is manufactured in 1/8, 5/32, 3/16 and 1/4-inch sizes of the standard 14 inch lengths.

New Welding Helmit is Electrically Operated

The Michigan Welding Supply Corporation, Muskegon, Mich., have recently put on the market an improved model of the Magno-Matic eye shield which was first announced last fall during the Metal Congress in Chicago. The Magno-Matic is

The Improved Magno-Matic Eye Shield.

a head shield of conventional general design, equipped with a special lens-shifting device which is operated by a magnet. A part of the welding current flows through the magnet so that the instant the arc is drawn, the magnet must project the safety lens before the operator's eyes. A single wire connection to this mechanism is so located that it does not inconvenience the operator. The welding lens itself is protected on both sides by clear glass. The outside glass is circular in shape and since only a part of it is exposed at any one time, it can be made to do a considerable term of duty by revolving it. It is claimed that the action of the shifting device is so smooth and instantaneous that the welder is practically unaware of any change, and at the same time operation is so positive that there is no opportunity for the harmful rays of the arc to reach the eyes. The operator has full view of his work when starting the arc and no time is lost in making adjustment for eye protection when the arc itself is either stopped or started.

Aluminum Welding Rod Requires No Flux

Announcement has been received from the Aluminum Fluxless Solder Company, 57 Kirkaldy Street, Dunedin, New Zealand, of a new welding material for the welding of aluminum, called the Alloy Fluxless Welding Stick. This has been especially developed for the welding of cast aluminum and its alloys, and such metals as Duralumin in the manufacture of such articles as carburetors, automobile door handles, radiator caps, etc., which have been found difficult to weld by the use of drawn aluminum rod and flux. At the present time this material is not now being sold on the American market, but the manufacturers are negotiating for the sale of patent rights to American manufacturers. The New Zealand firm also makes an interesting line of solders, including aluminum solder.

New T-20 Weco Welder for 220 Volt Circuit

The Warner Engineering Corporation, Pomona, Calif., manufacturers of the Weco Electric Torch, has just put on the market a new model No. T-20, which is for operation from a 220-volt, 60 cycle, alternating current. The outfit supplied includes an electric torch, and a complete metallic arc and carbon arc welding equipment with 30 feet of welding cable and electrode holders, a carbon contact type soldering iron, a welding helmet and a supply of carbon electrodes and connecting cables. The heat adjustment provides for twelve steps of heating and the current adjustment covers a range of from 8 to 150 amperes. The machine is provided with voltage regulation and voltage compensation ,and carries a volt meter which gives the line reading at any time.

New Low Melting Point Brazing Alloy

Handy & Harman, 57 William Street, New York, producers of silver solders and silver alloys in general, have applied for a patent on a new brazing alloy which they call Sil-Fos. It contains a small percentage of silver and is described as flowing freely at 1300 degrees F.

Sil-Fos promises to be worthy of consideration where higher melting point base-metal brazing or welding alloys cannot be used without danger of weakening, distorting or destroying the parts adjacent to the joint. The commercial silver solders containing 50 per cent silver, or less, require 1400 degrees to 1600 degrees F. to melt and the base-metal brazing alloys from 1600 degrees to 2100 degrees F. The new alloy is described as also possessing free-flowing properties, with deep and quick penetration. This characteristic is doubtless due to the silver in the alloy. In addition, it is pointed out that at 1400 degrees F., the flow point of borax flux with which it is generally applied, there is 100 degrees of superheat which increases the fluidity still further and aids penetration and alloying action. Another interesting feature claimed for it is that it requires less than the usual amount of flux because of the deoxidizing effect of the phosphorous in the alloy. This would seem to be an important advantage and should tend to reduce the cost of cleaning and finishing after joints have been made. Under certain conditions, satisfactory copper to copper joints can be made without using any flux.

As to strength, the makers report, for example, that lap joints of copper sheets show tensile strength of approximately 30,000 pounds per square inch. They also state that Sil-Fos can be used in many cases for joining brass, bronze, nickel, nickel-silver, extruded brass and bronze, monel metal, and other metals and alloys fusing above 1300 degrees F.

While containing silver, this alloy is not classed as a silver solder by its makers. It is sold by the avoirdupois pound rather than by the troy ounce, as are silver solders usually. The prices quoted range from $3.00 a pound, for thin strip in small quantities, down to $1.25 a pound for rods in large lots.

The Taylor Line of Fittings for Welding

The Tayor Forge & Pipe Works, Chicago, have developed a large line of seamless steel pipe fittings for welding consisting of elbows, tees, reducing tees, bull plugs, and reducing nipples, as well as forged steel butt welding flanges which have already been on the market for over three years. All sizes to 24-inch inclusive will be ready for distribution within the near future, but at this writing only sizes 12 inches and smaller are available. The tees are made in sizes 2 to 8 inches.

This line of fittings permits entire pipe systems fabricated by welding to be installed with only the use of cir-

Wide Variety of Forged Fittings for Pipe Welding.

cumferential welds so that installation is considerably simplified. These fittings are lighter in weight than cast steel fittings for the same service and therefore require fewer and lighter supports. The manufacturing methods are on a mass production basis employing patented processes to a great extent. The elbows are made without thinning or buckling of the walls, and further have the feature of short tangents to facilitate welding and accurate lining up. Elbows are made of the standard center to end measurement of American Standard Extra Heavy Screwed Fittings, and with end to center to end dimensions equal to one and one-half times the nominal pipe diameter. The ends are machine tool bevelled. Machine tool bevelling provides a smooth,

clean surface for welding, and contributes to accuracy as well as installation ease.

Taylor forged tees are a forged tubular product made to pipe thickness at the ends, with the body thickened up especially around the outlet to give required reinforcement. The basis of design for the tee, as well as the other welding products, has been to make the fittings of an intallation of welded fabricated pipe the strongest parts of the line. Flow or friction has also been carefully considered in design, the tees having sweep outlets.

The reducing nipples are designed especially for welding, with the length sufficiently long to aid installation, yet shorter in dimension than that of the screwed reducing nipple. The smooth, well balanced shape of the reducing section assists materially in fostering easy and unimpaired flow. The bull plugs are forged under the most approved forging conditions; formed to an ellipsoidal shape to withstand end pressure; and made with a surplus of straight section to enable easy and simple attachment to pipe. The Taylor butt welding flanges, providing for the insertion of valves in welded pipe installations, have a long fillet at the hub to prevent distortion, and are made to satisfy full American Standard strength requirements.

A New Metal for the Electrical Industry

The Westinghouse Electric & Manufacturing Company have recently announced "Hipernik," a new metal possessing unusual magnetic properties. This strange-sounding, synthetic name is made up of the first syllable of the two words "high permeability," the valuable property the metal possesses, and three letters from the word "nickel," which is one of its important elements.

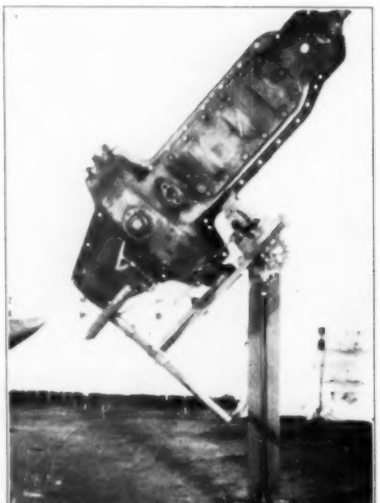
"Hipernik" is the most magnetic metal ever discovered, being 160,000 times as magnetic as air. It is over thirty times as magnetic as ordinary open hearth steel or iron, which have a maximum magnetic permeability under 5,000, as the scientists express it.

Many of the uses to which the new metal may be applied are still under the observation of research engineers. Its use has greatly improved radio receivers and sound amplifying systems. Instrument transformers, too, have been made smaller and are more efficient and accurate when the transformer core is made of "Hipernik."

For many years experimental work has been carried on by Dr. T. D. Yensen, manager of the Magnetic Division of Westinghouse's Research Laboratories. But the experimental production was on a small scale and very costly, so arrangements were made to produce it on a commercial basis at The American Rolling Mill Company, of Middletown, Ohio. "Hipernik" is now being rolled from 12,000 pound ingots, into coils many feet in length, on Armco's continuous sheet mills. The finished product is used either in sheet form or as cold rolled strip .014 inch in thickness. No difficulty has been experienced in welding this new alloy, but portions of the alloy in the immediate vicinity of the weld lose some of their magnetic properties. If the heat zone is kept at a minimum there does not appear to be a noticeable loss in the magnetic properties of the whole assembly.

A Welding Stand for the Repair Shop

The Universal Welding Stand is a device designed to minimize the time required for setting up a casting in the proper position to be welded. It is operated by a foot lever which turns to a level position the part to be welded, and locks automatically. The clamping device, which holds the part to be welded, is operated by a swivel vise of the ordinary type placed on a slotted bar. The clamp is of the ordinary type connected to the slotted bar by means of a universal sliding and locking device, which allows the welder or operator to meet all requirements in placing castings in their proper position for welding. The simplicity of operation is apparent in the photograph. The two important features



This Clamping Device Permits Placing Work in Any Convenient Position.

are the easy method of firmly securing the points of contact between the two parts to be welded and the simple method of adjusting the two parts to any position for the welding job without removing them from the clamp or vise. Once the two parts are secured in position for welding, they are not removed from the welding stand until the job is completed. This stands sells for $28.00 and is made by C. S. Anderson, Dwight, Illinois. This same manufacturer also produces a soldering stand of somewhat similar design, but made especially for soldering operations, such as radiator repair work.

Gas Cylinder Safety Carrier

The Carbo-Oxygen Company, Pittsburgh, Pa., recently put on the market a special carrier for gas cylinders. It consists of several members, the main one being a supporting beam constructed of standard steel pipe to one end of which is permanently attached a ring or collar constructed of ⅛-in. x 2-in. flat steel designed to hold the valve end (Cap attached) of Oxygen or similar type cylinders. This means of supporting the other end of this type cylinder

Cylinders Can Be Carried with Absolute Safety.

is a specially designed forked hook constructed of ¼-in. x 19½-in. flat steel, the upper end of which is attached to the hinged end portion of the supporting beam. This hook, which has two supporting lugs, is brought into place under and back of the base end of the cylinder to be carried by applying an upward lift to the hinged end portion of the supporting beam, the cylinder being released by reversing this action.

For carrying the recessed head type of acetylene cylinder two swinging hooks constructed of ¼-in. x 1¼-in. flat steel are provided. These are attached to the middle section of the supporting beam. They engage the rims of the concave top and bottom of this type cylinder. The forward hook is permanently fixed on the supporting beam, while the other hook is slid along the beam to the desired point and then tightened in place. To prevent this hook from changing its position a safety clamp is tightly attached to the supporting beam back of the sliding hook.

When convex head type acetylene cylinders are to be carried, the ring or collar previously mentioned for use with oxygen type cylinders, supports the valve (or top) end of the cylinder while the sliding hook and safety clamp are moved forward along the supporting beam to the required position and tightened in place. The sliding hook engages the rim of the base of this type cylinder.

Westinghouse Flex Arc A-C 100 Ampere Welder

A new alternating current arc welding set designed for operation at between 85 and 125 amperes has recently been developed by the Westinghouse Electric and Manufacturing Co. This new welder is produced for arc welding of thin gauge material such as that encountered in the manufacture of metal furniture, sheet iron cabinets and containers; in aircraft fabrication work; job and garage repair work; and in the fabrication and erection of ventilating and materials handling equipment of many kinds.

The FlexArc A-C welder may be used

in conjunction with either bare or coated electrodes from 3/32-in. to 1/8-in. diameter. It is stated that of the ferrous alloy materials commonly used with reversed polarity direct current are effectively and easily applied in conjunction with this welder. It has also proven highly successful in the welding of aluminum. This A-C unit is recommended by the manufacturers for work of such character that the more common 200-ampere motor generator type of welder is considered too large or expensive.

The entire equipment consisting of a special self-cooled transformer, short wave arc control system and current regulating details are substantially mounted in a compact welded steel case. With this machine, a special high frequency arc stabilizing circuit developed by Westinghouse eliminates the high open-circuit secondary voltage. The maximum open circuit voltage at the work is only 73 volts, thereby contributing to the safety of the operator. A short wave arc control system eliminates the interference to radio reception usually caused by an A-C welder. High operating economy is made possible by a high average power factor and low no-load power requirements. Low maintenance is secured by having no moving parts and a totally enclosed construction. It is light in weight, compact and readily portable.

Westinghouse Portable FlexArc A-C Welder.

Linde Announces New Type Goggles

The Linde Air Products Co., 30 East 42nd St., New York, N. Y., has recently introduced a new type of welders' goggles, designated as Oxweld No. 12. This new type is claimed to provide a high degree of comfort since they are designed to fit the eyes and are adjustable to conform to the individual nose. The edge of the cup coming in contact with the face is shaped to conform to the general contour of the welder's cheekbone and nose, thus fitting smoothly around the eyes. The eye-pieces are joined with a leather strap, adjustable by means of a metal buckle, so that they may be correctly spaced to the width of the face. Ventilation has been carefully considered in designing these goggles. Patented ventilation ports on each side of the eye-cups are so constructed that it is practically impossible for sparks or light to reach the inside of the cup. The depth of the cup is another feature, permitting ample circulation of cool air. A large field of vision has been provided by the use of 50 mm. diameter lenses. Brown color lenses, known as the "B" type, are available as with older type goggles and in addition, a new special quality green lens, known as the "A" type, is available in three different shades. Lenses may be easily changed by simply removing the metal cups which unscrew from the frames of the eye-pieces.

Oxweld No. 12 Welding Goggle.

The material of which these goggles are made is a molded plastic substance known as Oxweldite which is formed over a fabric base and is resistant to heat, light and electric current. The manufacturers claim that the entire construction of these goggles is such that they will readily withstand the usage to which goggles are subjected in welding shop or plant.

Announce Two New Fittings for Pipe Welding

The National Valve and Mfg. Co., Pittsburgh, Pa., have just placed on the market two fittings designed for use in connection with welded pipe assemblies, which make use of the loose flange principle. The manufacturers point out that there are many cases where it is necesary to include flanges in otherwise completely welded lines to provide for cleaning, changes, etc.

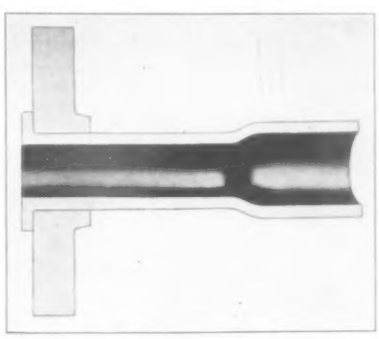


Figure 1. Cupweld Stub into Which Connecting Pipe is Inserted for Welding.

The Navco Cupweld Stub (Figure 1) is cupped just enough to permit the insertion of the line pipe and the joint is completed by making a fillet weld around the joint. The flange fits loosely on the stub so that it is not necessary to line up the bolt holes. It is also claimed that lining up of the pipe is made easier and any small errors in pipe length can be taken care of by adjusting the amount inserted into the cup. The Buttweld Stub is shown in Figure 2 and incorporates the same principles except that the pipe end is beveled 45 degrees for making the regulation butt weld. These fittings are available in two sizes to fit both standard and extra heavy pipe and in diameters ranging from ½ to 24 inches.

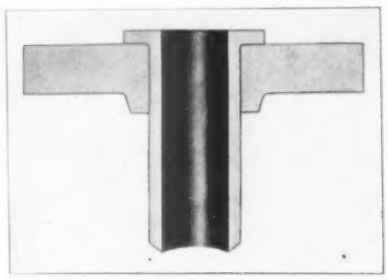


Figure 2. The Buttweld Stub for Ordinary Butt Joint.

News of the Industry

Al Joslin, welding shop owner on West Manchester, Los Angeles, Calif., recently moved into his newly constructed shop at 1047 West Manchester. The new shop is very attractive, and is equipped for all kinds of welding and repair work.

The A. F. Day Construction Co., of Dallas, Texas, have the contract for the welding of sixteen miles of pipe line running from Kilgore to Willow Springs and the Gladewater area. The work consists of a system of gathering lines in the east Texas oil fields. Welding is by electric arc.

A 12-inch acetylene welded pipe line is being constructed by the Sinclair-Texas Pipe Line Co., running from the Kilgore oil field in northern Rusk County to Colonels Station near Mexia.

W. A. Pitts, who has been with the Regan Forge & Engineering Company for the past several years in the Mid-Continent territory, is now connected with the American Iron & Machine Works Company of Oklahoma City, Okla.

A new welding shop was recently opened at 10671 San Fernando Road, near Roscoe, Calif., known as the Baker Garage and Welding Works. The new shop will feature fender work, general welding, motor repairing and ignition work.

The Western Pipe & Steel Company, of Los Angeles, Calif., recently completed the construction and welding of about two miles of 36-inch pipe for the city of Whittier. The line, which is an extension of the city's water main was welded by electric arc.

The Erie Welding & Metal Works has moved from 660 N. Wells Street to 208 W. Erie Street, Chicago. R. W. Austin, Proprietor of the company, states that they have recently secured a contract from Sawdura Company for the manufacture of molds to be used in making a new processed insulating material.

The Graver Tank & Mfg. Corp., East Chicago, Ind., has received the contract from A. E. Kemmer Company, general contractors, Lafayette, Indiana, to build for Purdue University a tank 75 ft. long, 16 ft. in diameter, with dome ends, using ½ inch plate. This tank will be arc welded throughout, and when completed will form a part of the water system of the university.

Executives of various branches of the metal industries will be members of a party of one hundred business men on a tour of research laboratories this fall, which is being organized under the sponsorship of the National Research Council. Among the research laboratories visited will be that of the Westinghouse Electric & Mfg. Co., at East Pittsburgh, Penn.

The Welding Engineering Company, 2872 N. 41st Street, Milwaukee, Wis., has been building up a complete line of welding supplies, and has in preparation a new 16-page welding supply catalogue which they expect to have ready for distribution in a few weeks.

Since his return from a tour of the British Empire, Major James Caldwell has accepted the invitation of the Quasi-Arc Company, Ltd., to join their research committee and assist in extending the application of electric welding to welded steel construction.

European industries are advancing very fast in the application of electrical resistance welding to their manufacturing processes. The Federal Machine & Welder Company of Warren, Ohio, state that they have recently shipped the largest automobile rear axle housing welder into Italy that has ever been installed in that country. They have shipped a great many welders to England, France and Germany in the last few months, so much so that it has demanded the attention of one of their authorities on welding. M. L. Eckman, a man of very broad experience and a development engineer of unusual ability is sailing on the S. S. Bremen, July 18, to supervise the installation of welding machinery in France, England, Germany and Italy. Mr. Eckman intends to assist in training the welding personnel of such large manufacturing concerns as Renault, Citroen, Fiat, Fried-Krupp and others. He also intends to spend some time in the lecture field in educational and instructive welding procedure.

Edw. Gier, proprietor of the A A A Portable Welding Service, 10314 S. State Street, Chicago, states that job welding business has been satisfactory in recent months and that he has recently added to the shop equipment a new 300 amp. USL arc welder.

The Independent Boiler & Tank Company, 1249 N. Clark Street, Chicago, expect to complete this month their contract at the Waukegan Generating Station, Waukegan, Ill., which is owned by the Public Service Company of Northern Illinois. This contract covered the erecting and welding of hot and cold air ducts, generating ducts and breechings. The job, when completed, will represent about 150,000 feet of arc welding on ⅜ inch and ¼ inch steel.

The Jones & Laughlin Steel Corporation recently started advertising the facilities afforded at their Chicago warehouse for supplying plate of irregular design and all thicknesses due to the installation of an oxygraph.

A. G. Bissell, consulting engineer in Seattle, Wash., specializing in electric arc welding, recently read a paper on the subject of "New Developments in Electric Welding" before the Electric Club of Seattle.

The Grays Harbor Veneer Company of Hoquiam, Wash., has recently added to their plant a 36-inch, 60-foot welded stack, which was erected by the Hupp Welding Company of Aberdeen, Wash.

The Fusion Welding Corporation, Chicago, announces the appointment of the Puritan Compressed Gas Corporation of Kansas City, Mo., as distributors for the Weldite line of welding rods. The territory served by the Puritan Compressed Gas Corporation will include the state of Kansas and the western portion of Missouri.

Maurice Taylor, welding technician for the Lincoln Electric Co., Cleveland, Ohio, sailed from San Francisco on June 20th for Tokyo, where he expects to confer with officials in charge of ship construction for the Imperial Japanese Navy and supervise the installation of electronic tornado automatic welding machinery in the factory of the Kawasaki Company. It is expected that the automatic equipment will be used for the manufacture of steel pipe from 30 to 72 inches in diameter.

Chas. P. Weekes, vice president in charge of eastern sales for the Hercules Motors Corporation, Canton, Ohio, sailed June 4th for Russia, where he will spend several weeks. During Mr. Weekes' absence, Mr. Wheeling will have charge of the Hercules Motor Corporation's eastern office in the Chanin Building, New York City.

The Welding Engineering Co., Bartlesville, Okla., has been awarded the contract for electric welding 124 miles of 26-inch pipe for the Southern Fuel Company, Los Angeles, Cal. The line runs from Kettleman Hills to Los Angeles. Construction is already well under way.

Lukenweld, Inc., Coatesville, Penn., has appointed W. R. McDonough & Co., as representative in the Cleveland district. Lukenweld is engaged in the design and manufacture of parts of machinery and equipment by gas cutting, forming and arc welding of rolled steel, its products being known as "Lukenweld construction." It is employed by many manufacturers of machinery and equipment for housings, frames, bases, beds, gear cases and other machinery and equipment parts. The Dravo-Doyle Company has been appointed as representative in the Pittsburgh district.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

HELP WANTED

Salesmen now calling on welding shops or iron foundries handle "ARC WEL" rods for machinable welds on cast iron as side line. 25% Comm. Northeast Metals Co. 4124 Torresdale Ave., Phila., Pa.

Due to changes in policy and sales organization, well-known manufacturer of arc welders and electric welding supplies desires additional distribution in the United States on Jobbing or commission basis. Will give qualified parties exceptional cooperation and protection. Address Box 456 The Welding Engineer.

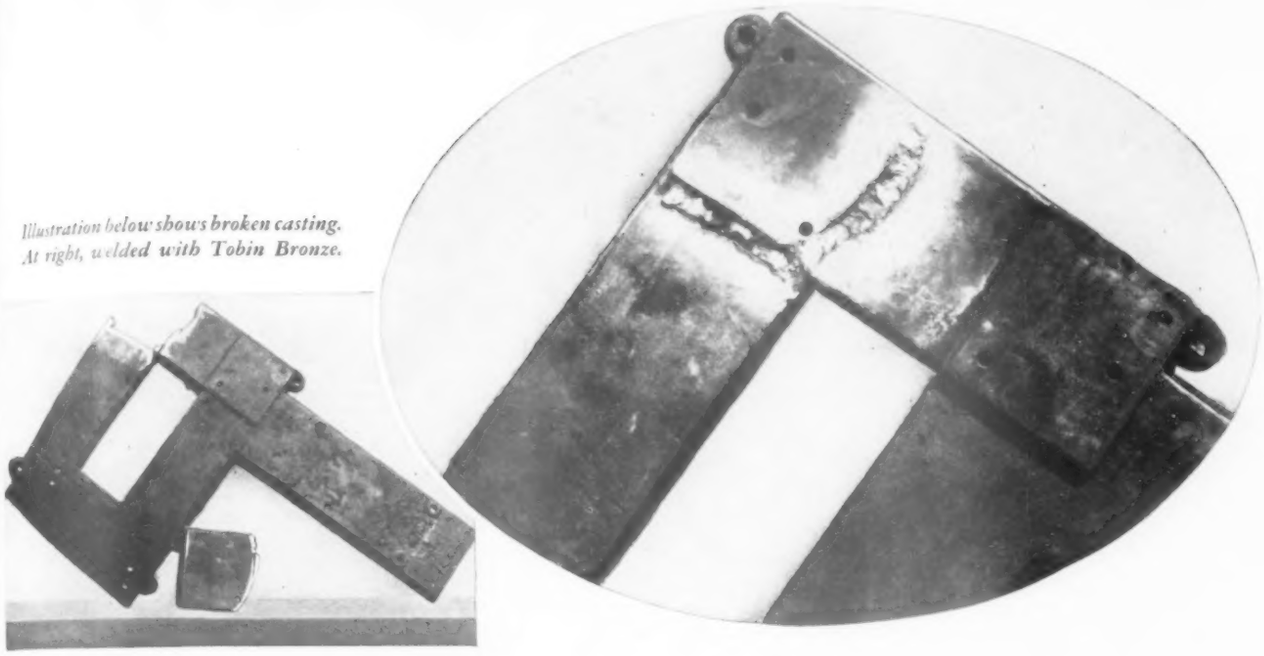


Illustration below shows broken casting. At right, welded with Tobin Bronze.

Preheating was unnecessary *with* TOBIN BRONZE

Tobin Bronze saves welding time because its low melting point — 1625°F.— usually makes preheating unnecessary.

In the case of the heavy casting illustrated—an iron base for the motor and drum of an elevator—Tobin Bronze welding was accomplished without preheating. After chipping the fracture, the job was completed in short order, using 110 feet of oxygen, 100 feet of acetylene, and 3-1/2 pounds of 3/16″ Tobin Bronze Rod.

This is typical of the way in which Tobin Bronze is saving time and money in the welding of broken castings. Publication B-13, containing complete information on Tobin Bronze and other Anaconda copper-alloy welding rods, will be mailed on request.

• • •

Anaconda Welding Rods are available through leading distributors of welding equipment and supplies. For those requiring small quantities, Anaconda Welding Rods can be obtained in clearly labeled ten pound packages.

ANACONDA
from mine to consumer

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Naval Bronze	1625° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

for arc welding

Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

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General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities

ANACONDA WELDING RODS

WANTED TO BUY

Oxygen Cylinders—220 cubic feet, standard used cylinders; tested, in good condition. 500 to 2000 required. Send full particulars to N. F. Baez, 653-C Calzada Del Cerro, Havana, Cuba.

Job Welding Shop—Must be able to stand thorough investigation. Give full particulars and terms. Address Box 425, The Welding Engineer.

FOR SALE

Arc Welders—Several rebuilt gasoline engine and electric motor driven arc welders in the 200 and 300 ampere sizes. Also welding generators suitable for direct or belt drive. Low price and attractive terms to responsible parties. Address Box 427, The Welding Engineer.

Welding and Machine Shop—Established 11 years, only exclusive shop in growing city of 35,000 population. Owner wishes to retire. Priced at a sacrifice. Address Electric Welding Works, 16 W. Haley St., Santa Barbara, Cal. t.f.

Welding Machines—On account of moving to new plant and installing alternating current, we have the following welding machines for sale:

1—400 ampere General Electric
1—300 ampere General Electric
1—300 ampere Lincoln
1—250 ampere General Electric
1—200 ampere Lincoln

All are ball bearing machines, first class shape. Motors 220 volts, direct current. Apply Quaker City Iron Works, Inc., Richmond and Tioga St., Philadelphia, Pa.

WELDERS—We have it now! The best flux on the market for brazing cast iron, regardless of rust. Perfect jobs on furnace grates, etc. **JOBBERS**—It will pay you to handle BRAZE ALL. WRITE! **SALESMEN**—Double your income.
Send $1.25 for Pound can, Postpaid or dime for large sample.
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34½ E. Washington Champaign, Illinois

POSITIONS WANTED

Welding expert—former instructor, practical experience in gas, arc and atomic welding, blacksmith and mechanical trades, 7 years demonstrator, constructor and salesman for large welding concern, desires position. Willing to do any work. Prefer company interested in his new inventions in gas and arc welding. Box 428, The Welding Engineer.

Combination Welder—5 years experience in job shop and industrial welding. Some experience in body and fender repair. Willing to travel. G. J. Diesler, 2155 W. 28th St., Cleveland, Ohio.

Arc Welder—long experience in various industries, desires permanent position with growing concern who appreciate good conscientious worker. Box 429, The Welding Engineer.

Gas Welder—Experienced, wishes position as plant welder or in factory. Free to go anywhere. Experienced in heavy steel, cast iron, hard facing. Walter Lackey, 1651 Pattie Ave., Wichita, Kan.

"Big Tom" Ridlon is looking for a job where a good combination man will be appreciated. World war veteran, age 33, good education, single. Go anywhere. Experience: job shop, pipe line, aircraft and instruction. Reply 1835 E. 79th St., Cleveland, Ohio.

Arc Welder—Skilled electrician with 2½ years arc welding and gas cutting experience. Studying gas welding. Desire position. Lambert Klose, 5323 W. 24th St., Cicero, Ill.

Combination-Layout—Experienced both gas and arc. Good education and expert knowledge of layout and can handle men. Willing to travel and can furnish best references. Louis C. McNutt, Gosport, Ind.

Combination Welder—15 years experience, familiar with all metals, capable of handling any job. Have supervised 90 men in a shipyard. Desire position with firm contemplating installation of welding equipment. Go anywhere. Jack Bumb, Jr., 1486 E. Milwaukee Ave., Detroit, Mich.

Salesman-Demonstrator—17 years experience welder-supervisor of Reclaim Dept. rebuilding worn frogs, switches, special work pertaining to street RR. tracks. Skill highly rated in exceptional references. Box 430, The Welding Engineer.

Combination Welder—Canadian, 13 years experience arc and gas welding: general repair, tank, pipe and boiler work. Read blue prints and lay out work. Desire good position. References. W. Tomlin, 77 Lambton Ave., Toronto 9, Canada.

Welding Superintendent—desires position in a good size plant where the need for improvement in welding operations is recognized. Can offer 13 years' experience in design, supervision, inspection, and cost estimating in plate fabrication work, pressure vessels, boilers, pipe fabrication, pipe line work, refinery work and structural steel fabrication. Willing to go anywhere. Can furnish references of the highest type. Box 431, The Welding Engineer.

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Will weld everything concerning aluminum and its alloys. Good for Arc Welding. Successfully introduced in Airplane industry. Prompt delivery.
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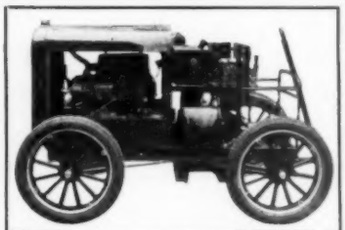

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